

AD-778 454

CALCULATED ABSORPTION COEFFICIENTS FOR  
LO-VIBRATIONAL CO LASER FREQUENCIES

R. K. Long, et al

Ohio State University

Prepared for:

Rome Air Development Center

March 1974

DISTRIBUTED BY:

**NTIS**

National Technical Information Service  
U. S. DEPARTMENT OF COMMERCE  
5235 Port Royal Road, Springfield Va. 22151

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER RADC-TR-74-05	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER AD 778454
4. TITLE (and Subtitle) Calculated Absorption Coefficients for 1-o-Vibrational CO Laser Frequencies.		5. TYPE OF REPORT & PERIOD COVERED Quarterly
7. AUTHOR(s) Long, R.K. and Mills, F.S.	6. PERFORMING ORG. REPORT NUMBER 3271-8	
9. PERFORMING ORGANIZATION NAME AND ADDRESS Electro-Science Laboratory Dept of Electrical Engineering Ohio State Univ, Columbus, OH		8. CONTRACT OR GRANT NUMBER(s) F30602-72-C-0016
11. CONTROLLING OFFICE NAME AND ADDRESS Advanced Research Projects Agency 1400 Wilson Blvd Arlington, VA 22209		10. PROGRAM ELEMENT PROJECT, TASK AREA & WORK UNIT NUMBERS 62301D 12790502
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) Rome Air Development Center RADC/OCSE Griffiss AFB, NY 13441		12. REPORT DATE March 74
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited		13. NUMBER OF PAGES 97
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report) Same		15. SECURITY CLASS. (of this report) UNCLASSIFIED
18. SUPPLEMENTARY NOTES Monitored by: James W. Cusack, RADC/OCSE Griffiss AFB NY 13441		15a. DECLASSIFICATION DOWNGRADING SCHEDULE N/A
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Atmospheric                      Water Vapor Laser Propagation              Molecular Absorption CO                                  Infrared Absorption Carbon Monoxide Laser		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) CO lasers operating on the lower vibrational bands (4-3, 3-2, 2-1, 1-0) will suffer less atmospheric absorption loss than higher band CO lasers due mainly to operation further from the 6.3μ water vapor band.  In this report the APCRL absorption line-data tape is used to compute the CO, CO <sub>2</sub> , and H <sub>2</sub> O absorption coefficients for the mid-		

DD FORM 1 JAN 73 1473

EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)

LATITUDE summer model and 115 laser frequencies of the 5-4 to 1-0 CO bands for altitudes of sea level, 3 km, and 6 km.

It is found that at sea level 17 of these lines have a lower absorption coefficient than the P(20) CO<sub>2</sub> laser line for the same atmospheric model.

The calculated results are being used to guide the selection of lines to be investigated in a laboratory measurement program utilizing either a CO laser or PbS<sub>2</sub> laser diodes having output in the same frequency range as the CO laser.

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)

ia/

CALCULATED ABSORPTION COEFFICIENTS FOR  
LO-VIBRATIONAL CO LASER FREQUENCIES

R. K. Long  
F. S. Mills

Contractor: The Ohio State University  
Contract Number: F30602-72-C-0016  
Effective Date of Contract: 23 June 1971  
Contract Expiration Date: 31 August 1974  
Amount of Contract: \$330,718.00  
Program Code Number: OE20

Principal Investigator: Dr. Ronald K. Long  
Phone: 614 422-6077

Contract Engineer: James W. Cusack  
Phone: 315 330-3145


Approved for public release;  
distribution unlimited.

This research was supported by the  
Defense Advanced Research Projects  
Agency of the Department of Defense  
and was monitored by James W. Cusack,  
RADC (OCSE), CAFB, NY 13441 under  
Contract F30602-72-C-0016.

## FOREWORD

This report, Ohio State University Research Foundation Report 3271-8 (eighth Quarterly Report), was prepared by the Ohio State University ElectroScience Laboratory, Department of Electrical Engineering at Columbus, Ohio. Research was conducted under Contract F30602-72-C-0016. Mr. James W. Cusack, RADC-OCSE, of Rome Air Development Center, Griffiss Air Force Base, New York, is the Project Engineer.

This technical report has been reviewed and is approved.

  
RADC Project Engineer

## TABLE OF CONTENTS

	Page
I. INTRODUCTION	1
II. TABULATED RESULTS	1
III. SPECTRAL PLOTS	2
IV. CONCLUSIONS	3
REFERENCES	4

## I. INTRODUCTION

This report presents calculations based on the AFCRL line-data tape[1] at 115 lines of the CO laser. Specifically, the lines studied are: (a) 5-4  $J = 1$  to 20; (b) 4-3  $J = 1$  to 25; (c) 3-2  $J = 1$  to 25; (d) 2-1  $J = 1$  to 25; and (e) 1-0  $J = 6$  to  $J = 25$ .

The laser frequencies were computed from molecular constants given by Rao et. al.[2].

The atmospheric model was the AFCRL mid-latitude summer model[3] which is given in Table I.

The method of calculation has been described in detail in a recent report[4]. The only difference is that for this work both a Lorentz and a super-Lorentz line shape were used in the calculation of the water vapor absorption coefficients. The particular form of this line shape has been described in an earlier report[5] and is based upon comparison with experimental absorption coefficients obtained with a CO laser which operated on the higher vibrational bands[6].

The AFCRL data tape includes data on absorption lines of seven gases ( $H_2O$ ,  $CO_2$ ,  $CO$ ,  $O_3$ ,  $H_2O$ ,  $CH_4$ , and  $O_2$ ) but in the wavelength band of interest here, only  $CO$ ,  $CO_2$ , and  $H_2O$  cause significant absorption. Ozone in sea level concentration can cause an absorption coefficient of  $0.003 \text{ km}^{-1}$  at some of the frequencies studied but this is insignificant in comparison with the water vapor absorption.

Hence only  $CO$ ,  $CO_2$ , and  $H_2O$  absorption coefficients were included in the tabulations. No water vapor continuum absorption coefficient has as yet been identified for this region.

The lowest pressure used was 365 torr corresponding to an altitude of 6 km. At this pressure it is not necessary to use a Voigt line shape[1].

## II. TABULATED RESULTS

The results are presented in Tables II-VI and IX-XVIII and are largely self-explanatory. The coefficients are in  $\text{km}^{-1}$ . Water vapor coefficients and total coefficients have been given for both the Lorentz and super-Lorentz line shapes. Thus the reader may see the magnitude of the change introduced by the altered line shape and may choose to use either result. Based on experimental work to date at Ohio State University, we believe that for this wavelength region the enhanced wing line shape for water vapor gives a calculated result which will be in better agreement with experimental measurement than that obtained using the Lorentz shape. Calculations have been included for horizontal paths at three altitudes: sea level, 3 km, and 6 km.



One way to examine the results is to compare them with the absorption coefficient for the P(20) CO<sub>2</sub> laser line for the same atmospheric condition. The 10.59  $\mu$  CO<sub>2</sub> absorption coefficient for the summer sea level model is approximately 0.3 km<sup>-1</sup>. Assuming that the calculations using the super-Lorentz line shape most nearly represent true values, one can list the CO laser lines which have a predicted coefficient which is lower than 0.3 km<sup>-1</sup>. The 17 CO lines which satisfy this condition are listed in Table VII.

Recent work by Dr. John Daiber at Calspan Inc. with electrically excited supersonic CO lasers has shown that it is possible to achieve significant power output at high efficiency on certain lines of the 5-4, 4-3, 3-2, and 2-1 CO bands[7]. These lines are listed in Table VIII together with the sea level CO<sub>2</sub> and H<sub>2</sub>O absorption coefficients from Tables II through V. It is seen that CO<sub>2</sub> absorption is significant for only one line (2-1 10). Also by comparing Tables VII and VIII it is seen that five of the lines obtained in the Calspan laser are among the best CO lines in the group of 115 studied. For completeness it should be said that the 2-1 lines have not yet been observed in actual devices at Calspan but, based on calculations, they are expected in the next generation of lasers now under construction. Of course the absorption coefficients for all lines are much less for the higher altitude paths as can be seen from an examination of Tables IX-XVIII.

A recent experimental study of CO laser absorption by H<sub>2</sub>O[8] found that the lowest absorption occurred for the 5-4 15 line and had a measured value of 0.66 km<sup>-1</sup> for a laboratory condition which approximated the mid-latitude summer sea level model. The calculated result from Table II is 0.437 km<sup>-1</sup> even with the super-Lorentz line shape. Using the 0.437 km<sup>-1</sup> condition there are 30 lines in Tables II-VI which have a coefficient lower than 0.437 km<sup>-1</sup> and an additional 19 lines having a coefficient lower than 0.66 km<sup>-1</sup>.

W. Q. Jeffers et. al.[8,9] have reported a cw O/CS<sub>2</sub> CO chemical laser using N<sub>2</sub>O as a diluent which has more than 50 percent of its output in the 6-5 to 2-1 vibrational bands. More recent results[10] indicate that it is possible to achieve operation on any lines from J = 2 to J = 25 of the 2-1 and higher bands.

Thus it appears that it may be possible to achieve efficient laser operation on lines which have low atmospheric absorption coefficients. Further work on both devices and propagation seems indicated.

### III. SPECTRAL PLOTS

Sixty-nine spectral plots have been made for the 1970-2115 cm<sup>-1</sup> range which includes all but seven of the lines in Tables II-VI. The approximate frequency of each of the laser lines is noted on the plots.



Separate plots are given for water vapor, carbon dioxide and carbon monoxide absorbers, and for a composite of the three. All of the plots assume sea level pressure and 294 °K temperature. A Lorentz line shape was used throughout.

Figures 1-16 are for water vapor. A path length of one km and water vapor pressures of 1.5 to 10 torr were used, with the absorber concentration selected for an on-scale plot in each wavenumber region.

Figures 17-34 are for CO<sub>2</sub> absorber. Partial pressures of 0.27 to 10. torr were used so that the absorption lines would be clearly visible in each region.

Figures 35-50 are for CO absorber and partial pressures of 10<sup>-4</sup> to 1.0 torr. One can observe the coincidence of 1-0 band laser lines with atmospheric CO absorption lines in this region.

Figures 51-69 are plots for a composite atmosphere consisting of CO, H<sub>2</sub>O, and CO<sub>2</sub> absorbers at the sea level concentrations given in Table I. A one kilometer path was assumed.

#### IV. CONCLUSIONS

Sufficient tabulated and plotted data has been presented to enable evaluation of practical applications employing the low vibrational CO laser. The plots should also be useful in planning high resolution spectroscopic studies using either conventional techniques or tunable lasers. An experimental investigation is underway to measure some of the coefficients using a one km laboratory absorption cell and a tunable laser diode source.

#### REFERENCES

1. R.A. McClatchey, et. al., AFCRL-TR-73-0096, January 1973.
2. Rao, K.N., et. al., J. Mol. Spec., Vol. 39, p. 180, 1971.
3. R.A. McClatchey, et. al., AFCRL-72-0497, August 1972.
4. R.K. Long, et. al., RADC-TR-73-389, November 1973.
5. R.K. Long, et. al., RADC-TR-73-126, March 1973.
6. C. Freed, Appl. Phys. Ltrs., Vol. 18, No. 10, P. 458, 15 May 1971.
7. J. Daiber, Private Communication.
8. W.Q. Jeffers, McDonnell Douglas Research Labs, Report MDC-Q-0495, 23 May 1973.
9. W.Q. Jeffers and C.E. Wiswall, "Efficient, Low Band Operation of a CO Chemical Laser," Preprint.
10. W.Q. Jeffers, Private Communication.

TABLE I  
Parameters of the AFCRL Mid-Latitude Summer  
Model for Three Altitudes

	Altitude in Kilometers		
	0	3	6
Temperature (°K)	294	279	261
Pressure (torr)	759.8	532.5	365.3
P <sub>H<sub>2</sub>O</sub> (torr)	14.26	3.19	.551
P <sub>CO<sub>2</sub></sub> (torr)	.251	.176	.121
P <sub>CO</sub> (torr)	5.7E-5	3.99E-5	2.74E-5
P <sub>N<sub>2</sub>O</sub> (torr)	2.13E-4	1.49E-4	1.02E-4
P <sub>CH<sub>4</sub></sub> (torr)	1.216E-3	8.52E-4	5.84E-4
P <sub>O<sub>3</sub></sub> (torr)	2.31E-5	3.22E-5	4.88E-5

TABLE II  
Calculated 5-4 Band Absorption Coefficients (in  $\text{km}^{-1}$ ) for  
Mid-latitude Summer Sea Level Model

LINE	IN	CO	CO2	H2O LORENTZ	TOTAL LORENTZ	H2O SUPER LORENTZ	TOTAL SUPER LORENTZ
1957.199	5-4	20	7.42E -3	1.69E 0	1.70E 0	2.19E 0	2.20E 0
1961.541	5-4	19	4.85E -4	8.06E 0	8.06E 0	8.37E 0	8.37E 0
1965.851	5-4	16	2.32E -4	1.67E 1	1.67E 1	1.85E 1	1.85E 1
1970.129	5-4	17	3.61E -3	1.56E 0	1.56E 0	2.31E 0	2.31E 0
1974.374	5-4	16	9.77E -5	3.23E -1	3.23E -1	6.02E -1	6.02E -1
1978.586	5-4	15	3.90E -4	2.14E -1	2.14E -1	4.37E -1	4.37E -1
1982.766	5-4	14	4.53E -5	3.93E -1	3.93E -1	6.72E -1	6.72E -1
1986.913	5-4	13	1.58E -4	1.96E 0	1.96E 0	2.84E 0	2.84E 0
1991.026	5-4	12	1.24E -5	1.01E 1	1.01E 1	1.35E 1	1.35E 1
1995.107	5-4	11	1.21E -4	1.28E 0	1.28E 0	2.09E 0	2.09E 0
1999.154	5-4	10	2.14E -4	1.42E 1	1.42E 1	1.39E 1	1.39E 1
2003.167	5-4	9	1.79E -4	2.95E -1	2.95E -1	4.95E -1	4.95E -1
2007.147	5-4	8	1.91E -3	1.40E 0	1.40E 0	1.69E 0	1.69E 0
2011.093	5-4	7	6.76E -5	7.76E -1	7.76E -1	9.99E -1	9.99E -1
2015.005	5-4	6	1.67E -3	1.31E 0	1.31E 0	1.99E 0	1.99E 0
2019.983	5-4	5	2.54E -4	1.93E 1	1.93E 1	1.94E 1	1.94E 1
2022.726	5-4	4	3.74E -4	3.86E 0	3.86E 0	4.05E 0	4.05E 0
2026.535	5-4	3	1.45E -3	2.25E 1	2.25E 1	2.17E 1	2.17E 1
2030.310	5-4	2	3.31E -4	1.43E -1	1.43E -1	2.35E -1	2.35E -1
2034.050	5-4	1	4.35E -3	1.07E 1	1.07E 1	1.03E 1	1.03E 1

TABLE III  
Calculated 4-3 Band Absorption Coefficients (in  $\text{km}^{-1}$ ) for  
Mid-latitude Summer Sea Level Model

LINE	ID	CO	CO2	H2O LORENTZ	TOTAL LORENTZ	H2O SUPER LORENTZ	TOTAL SUPER LORENTZ
1960.410	4-3 25	3.93E-10	1.22E-2	2.04E 0	2.05E 0	2.63E 0	2.64E 0
1964.946	4-3 24	9.43E-10	4.95E-4	2.72E 0	2.72E 0	2.96E 0	3.96E 0
1969.451	4-3 23	2.32E-9	1.46E-4	2.46E 0	2.46E 0	3.51E 0	3.51E 0
1973.924	4-3 22	7.89E-9	1.37E-4	3.05E-1	3.05E-1	5.97E-1	5.97E-1
1978.365	4-3 21	2.40E-8	1.23E-3	2.24E-1	2.27E-1	4.50E-1	4.51E-1
1982.774	4-3 20	6.50E-8	4.58E-3	3.97E-1	3.97E-1	6.75E-1	6.75E-1
1987.152	4-3 19	9.93E-8	2.87E-3	2.98E 0	2.98E 0	3.96E 0	3.96E 0
1991.497	4-3 18	4.77E-7	5.52E-3	4.24E 1	4.24E 1	4.78E 1	4.78E 1
1995.810	4-3 17	1.18E-6	7.34E-3	8.93E-1	8.93E-1	1.53E 0	1.53E 0
2000.090	4-3 16	3.00E-6	2.49E-3	1.24E 0	1.24E 0	1.58E 0	1.58E 0
2004.337	4-3 15	2.33E-5	9.06E-3	2.41E-1	2.41E-1	4.35E-1	4.35E-1
2008.552	4-3 14	2.80E-4	2.85E-4	1.14E 0	1.14E 0	1.46E 0	1.46E 0
2012.734	4-3 13	1.70E-3	8.75E-3	4.83E-1	4.83E-1	7.71E-1	7.71E-1
2016.882	4-3 12	1.72E-3	5.12E-4	4.68E-2	4.68E-2	4.49E-2	4.49E-2
2020.998	4-3 11	4.70E-3	2.79E-4	6.87E-1	6.87E-1	1.07E 0	1.07E 0
2025.080	4-3 10	4.79E-4	6.94E-4	3.96E-1	3.96E-1	6.04E-1	6.04E-1
2029.126	4-3 9	2.10E-4	8.74E-4	1.41E-1	1.42E-1	2.52E-1	2.53E-1
2033.143	4-3 8	7.29E-3	4.94E-4	1.36E-1	1.40E-1	2.30E-1	2.31E-1
2037.124	4-3 7	1.23E-3	9.31E-3	4.51E-1	4.52E-1	5.66E-1	5.77E-1
2041.071	4-3 6	8.64E-3	3.66E-3	1.71E 1	1.71E 1	1.74E 1	1.74E 1
2044.984	4-3 5	4.32E-3	4.25E-3	6.03E-1	6.07E-1	8.34E-1	8.36E-1
2048.062	4-3 4	3.74E-3	3.27E-2	1.84E-1	2.21E-1	2.55E-1	2.88E-1
2052.704	4-3 3	4.61E-3	8.04E-3	6.80E-2	7.61E-2	1.20E-1	1.28E-1
2056.516	4-3 2	1.05E-4	5.46E-2	6.74E-2	1.22E-1	1.31E-1	1.86E-1
2060.291	4-3 1	7.97E-4	1.30E-2	1.07E 1	1.07E 1	1.03E 1	1.03E 1

TABLE IV  
Calculated 3-2 Band Absorption Coefficients (in  $\text{km}^{-1}$ ) for  
Mid-latitude Summer Sea Level Model

LINE	ID	CO	CO2	H2O LORENTZ	TOTAL LOFFENTZ	H2O SUPER LORENTZ	TOTAL SUPER LORENTZ
1905.820	3-2 25	6.47E -6	3.45E -5	8.30E -1	8.30E -1	1.39E 0	1.39E 0
1990.452	3-2 24	3.30E -6	2.09E -5	4.44E 0	4.44E 0	6.61E 0	6.61E 0
1994.991	3-2 23	2.73E -6	8.51E -5	1.33E 0	1.33E 0	2.19E 0	2.19E 0
1999.499	3-2 22	3.11E -6	7.03E -5	2.74E 0	2.74E 0	3.15E 0	3.15E 0
2003.976	3-2 21	7.39E -6	1.28E -5	2.37E -1	2.33E -1	4.31E -1	4.32E -1
2008.420	3-2 20	5.59E -5	1.34E -4	1.30E 0	1.36E 0	1.68E 0	1.68E 0
2012.632	3-2 19	5.29E -5	8.42E -5	5.80E -1	5.80E -1	8.78E -1	8.78E -1
2017.212	3-2 18	4.52E -5	1.20E -4	2.21E 1	2.21E 1	2.43E 1	2.43E 1
2021.541	3-2 17	1.72E -5	8.90E -4	5.91E -1	5.92E -1	8.35E -1	8.35E -1
2025.875	3-2 16	1.31E -5	6.18E -4	8.91E -1	8.92E -1	1.09E 0	1.09E 0
2030.158	3-2 15	1.20E -5	5.29E -4	2.42E -1	2.50E -1	3.38E -1	3.38E -1
2034.404	3-2 14	1.48E -5	1.04E -3	6.80E -1	6.91E -1	7.65E -1	7.65E -1
2038.624	3-2 13	1.96E -5	6.09E -3	2.93E -1	3.04E -1	4.83E -1	4.83E -1
2042.808	3-2 12	3.27E -5	2.03E -2	1.17E 0	1.19E 0	1.61E 0	1.61E 0
2046.954	3-2 11	9.28E -5	5.05E -3	6.80E -1	6.85E -1	7.95E -1	7.95E -1
2051.075	3-2 10	1.03E -3	8.78E -3	2.81E -1	2.91E -1	3.27E -1	3.27E -1
2055.159	3-2 9	1.26E -3	3.68E -1	9.57E -2	4.65E -1	1.46E -1	1.46E -1
2059.209	3-2 8	2.46E -4	1.09E -2	4.35E -1	4.40E -1	5.76E -1	5.76E -1
2063.225	3-2 7	1.52E -4	2.07E -2	6.20E -1	6.41E -1	9.20E -1	9.20E -1
2067.206	3-2 6	1.33E -4	2.69E -2	5.13E -1	5.40E -1	7.63E -1	7.63E -1
2071.154	3-2 5	1.43E -4	7.67E -3	9.12E -2	9.92E -2	1.61E -1	1.61E -1
2075.063	3-2 4	1.00E -4	8.76E -3	2.54E -1	2.63E -1	3.36E -1	3.36E -1
2078.947	3-2 3	3.31E -4	1.34E -1	3.95E -1	5.30E -1	4.35E -1	4.35E -1
2082.792	3-2 2	9.01E -4	5.16E -3	7.84E -2	8.45E -2	1.20E -1	1.20E -1
2086.601	3-2 1	7.80E -3	3.65E -3	3.01E -1	3.12E -1	3.98E -1	3.98E -1



TABLE V  
Calculated 2-1 Band Absorption Coefficients (in  $\text{km}^{-1}$ ) for  
Mid-latitude Summer Sea Level Model

LIN	ID	CO	CO2	H2O LORENTZ	TOTAL LORENTZ	H2O SUPER LORENTZ	TOTAL SUPER LORENTZ
2011.419	2-1 25	2.37E -6	1.03E -4	3.27E -1	3.27E -1	5.72E -1	5.72E -1
2016.025	2-1 24	6.88E -6	1.69E -4	5.81E 0	5.81E 0	7.41E 0	7.41E 0
2020.600	2-1 23	5.07E -5	3.67E -4	1.67E 0	1.67E 0	2.07E 0	2.07E 0
2025.143	2-1 22	1.75E -4	5.31E -4	4.26E -1	4.26E -1	5.32E -1	5.32E -1
2029.655	2-1 21	1.31E -4	7.12E -4	1.70E -1	1.71E -1	2.69E -1	2.70E -1
2034.134	2-1 20	2.86E -5	2.04E -3	5.49E 0	5.49E 0	5.34E 0	5.34E 0
2038.581	2-1 19	2.07E -5	8.99E -3	2.94E -1	3.03E -1	4.76E -1	4.85E -1
2042.094	2-1 18	2.64E -5	1.03E -1	1.14E 0	1.24E 0	1.54E 0	1.66E 0
2047.377	2-1 17	4.42E -5	4.20E -2	2.57E -1	2.99E -1	3.68E -1	4.10E -1
2051.720	2-1 16	8.59E -5	1.43E -2	8.24E -1	8.34E -1	8.44E -1	8.58E -1
2056.047	2-1 15	2.08E -4	9.18E -3	1.05E -1	1.18E -1	1.66E -1	1.75E -1
2060.332	2-1 14	6.41E -4	1.18E -2	1.57E 1	1.57E 1	1.51E 1	1.51E 1
2064.583	2-1 13	4.26E -3	6.96E -2	1.02E 1	1.03E 1	1.12E 1	1.13E 1
2068.802	2-1 12	3.93E -2	2.09E -2	1.49E -1	2.09E -1	2.66E -1	3.26E -1
2072.965	2-1 11	3.71E -3	1.71E -2	2.73E -1	2.94E -1	3.48E -1	3.69E -1
2077.140	2-1 10	1.89E -3	7.07E -1	1.57E -1	8.64E -1	2.01E -1	9.10E -1
2081.258	2-1 9	2.19E -3	8.82E -3	1.13E -1	1.24E -1	1.57E -1	1.68E -1
2085.341	2-1 8	9.23E -4	1.37E -2	1.40E -1	1.55E -1	1.91E -1	2.06E -1
2089.394	2-1 7	7.77E -4	4.19E -3	1.25E 0	1.25E 0	1.54E 0	1.54E 0
2093.411	2-1 6	6.61E -4	2.74E -1	6.27E -1	9.02E -1	6.51E -1	9.26E -1
2097.394	2-1 5	6.31E -4	3.64E -3	1.06E 1	1.04E 1	1.00E 1	1.00E 1
2101.342	2-1 4	6.53E -4	7.01E -3	8.92E -2	9.89E -2	1.20E -1	1.28E -1
2105.256	2-1 3	7.17E -4	4.27E -3	8.70E -2	9.20E -2	1.11E -1	1.16E -1
2109.136	2-1 2	8.32E -4	1.21E -2	3.17E -2	4.46E -2	4.91E -2	6.20E -2
2112.981	2-1 1	1.06E -3	5.15E -3	7.24E -2	7.84E -2	1.11E -1	1.17E -1



TABLE VI  
Calculated 1-0 Band Absorption Coefficients (in  $\text{km}^{-1}$ ) for  
Mid-latitude Summer Sea Level Model

LINE	IN	CO	CO2	H2O LORENTZ	TOTAL LORENTZ	H2O SUPER LORENTZ	TOTAL SUPER LORENTZ
2037.026	1-0 25	5.87E -3	2.16E -2	3.42E -1	3.69E -1	4.62E -1	4.89E -1
2041.567	1-0 24	1.04E -2	9.03E -3	3.74E -1	3.74E -1	3.67E -1	3.67E -1
2046.277	1-0 23	1.28E -2	1.26E -2	1.80E 0	1.83E 0	1.86E 0	1.89E 0
2050.855	1-0 22	1.87E -2	2.06E -2	8.76E -2	1.27E -1	1.42E -1	1.81E -1
2055.401	1-0 21	2.61E -2	3.57E -2	5.90E -2	1.25E -1	1.14E -1	1.80E -1
2059.915	1-0 20	3.69E -2	1.22E -1	1.50E 0	1.66E 0	1.69E 0	1.85E 0
2064.398	1-0 19	4.83E -2	3.16E -1	4.37E 0	4.74E 0	5.30E 0	5.67E 0
2068.848	1-0 18	6.58E -2	2.53E -2	1.42E -1	2.39E -1	2.63E -1	3.54E -1
2073.266	1-0 17	8.60E -2	2.07E -2	3.50E -1	4.97E -1	4.70E -1	5.77E -1
2077.651	1-0 16	1.10E -1	4.69E -1	1.67E -1	7.66E -1	2.14E -1	8.13E -1
2082.003	1-0 15	1.35E -1	1.01E -2	2.64E 0	2.79E 0	2.56E 0	2.71E 0
2086.323	1-0 14	1.69E -1	9.66E -3	1.83E -1	3.62E -1	2.65E -1	4.44E -1
2090.610	1-0 13	2.01E -1	2.60E -3	1.81E 0	2.01E 0	2.14E 0	2.34E 0
2094.864	1-0 12	2.33E -1	1.42E -2	2.51E -1	4.98E -1	2.78E -1	5.25E -1
2098.084	1-0 11	2.65E -1	3.60E -3	6.77E -2	3.36E -1	1.00E -1	3.69E -1
2102.271	1-0 10	2.92E -1	1.95E -3	2.16E -1	5.10E -1	2.27E -1	5.21E -1
2107.426	1-0 9	3.12E -1	1.27E -2	1.34E 0	1.64E 0	1.31E 0	1.63E 0
2111.544	1-0 8	3.24E -1	5.20E -3	1.60E -1	4.95E -1	1.82E -1	5.11E -1
2115.630	1-0 7	3.25E -1	6.31E -3	4.80E -1	8.11E -1	5.68E -1	9.19E -1
2119.682	1-0 6	3.09E -1	2.04E -2	3.41E -2	3.63E -1	4.99E -2	3.79E -1

TABLE VII

Absorption Coefficient for Mid-latitude Summer Sea Level Model  
and Super Lorentz Line Shape for CO Laser Lines Having a  
Predicted Coefficient of Less Than  $0.30 \text{ km}^{-1}$

IDEN		ABSORPTION COEFFICIENT $\text{km}^{-1}$	
5-4	2	2030.310	.235
4-3	9	2029.128	.253
	8	2033.143	.231
	4	2048.162	.288
	3	2052.706	.128
	2	2056.516	.186
3-2	5	2071.154	.169
	2	2082.792	.126
2-1	21	2029.655	.270
	15	2056.047	.175
	9	2081.258	.168
	8	2085.343	.206
	4	2101.342	.128
	3	2105.256	.116
	2	2109.136	.062
1-0	22	2050.855	.181
	21	2055.401	.180

TABLE VIII

Calculated Mid-latitude Summer Sea Level Absorption Coefficients  
for the CO Laser Lines Observed in the Calspan Inc. Laser

<u>IDEN</u>		<u><math>\nu_0</math></u>	<u><math>k_{CO_2}</math></u>	<u><math>k_{H_2O}^{SL}</math></u>	<u>TOTAL</u>
5-4	8	2007.147	.0019	1.69	1.69
	7	2011.093	.000068	.999	.999
	6	2015.005	.00167	1.99	1.99
	5	2018.883	.00025	19.4	19.4
	4	2022.726	.000374	4.05	4.05
4-3	8	2033.143	.00049	.230	.231
	7	2037.124	.0093	.566	.577
	6	2041.071	.00386	$1.74 \times 10^1$	$1.74 \times 10^1$
	5	2044.984	.00425	.834	.834
	4	2048.862	.0327	.255	.288
3-2	8	2059.209	.0109	.576	.587
	7	2063.225	.0207	.920	.941
	6	2067.206	.0269	.763	.790
	5	2071.154	.00787	.161	.169
	4	2075.068	.00876	.336	.345
2-1	10	2077.140	.707	.201	.910
	9	2081.258	.00882	.157	.168
	8	2085.343	.0137	.191	.206

TABLE IX  
Calculated 5-4 Band Absorption Coefficients (in  $\text{km}^{-1}$ ) for  
Mid-latitude Summer Model at 3 km Altitude

LINE	ID	CO	CO2	H2O LORENTZ	TOTAL LORENTZ	H2O SUPER LORENTZ	TOTAL SUPER LORENTZ
1957.199	5-4 20	7.10E-11	5.49F -3	2.91E -1	2.94E -1	3.92E -1	3.97E -1
1961.541	5-4 19	1.83E-10	2.49F -4	1.21E 0	1.21E 0	1.33E 0	1.33E 0
1965.031	5-4 18	4.05E-10	1.09F -4	2.43E 0	2.43E 0	2.90E 0	2.90E 0
1970.129	5-4 17	9.55E-10	2.87F -3	2.14E -1	2.14E -1	3.48E -1	3.50E -1
1974.374	5-4 16	3.64E -9	4.35F -5	4.76E -2	4.76E -2	9.54E -2	9.54E -2
1978.586	5-4 15	8.65E -9	1.76F -4	3.08E -2	3.10E -2	6.85E -2	6.87E -2
1982.766	5-4 14	2.26E -8	2.25F -5	5.21E -2	5.21E -2	1.05E -1	1.05E -1
1986.913	5-4 13	4.16E -8	1.10F -4	2.75E -1	2.75E -1	4.33E -1	4.33E -1
1991.024	5-4 12	8.56E -7	5.04F -6	1.45E 0	1.45E 0	2.11E 0	2.11E 0
1995.107	5-4 11	6.64E -7	9.53F -5	1.81E -1	1.81E -1	3.24E -1	3.24E -1
1999.154	5-4 10	6.09E -5	1.06F -4	2.40E 0	2.40E 0	2.38E 0	2.38E 0
2003.167	5-4 9	2.11E -6	1.01F -4	4.07E -2	4.08E -2	7.44E -2	7.45E -2
2007.147	5-4 8	7.90E -7	1.45F -3	1.86E -1	1.87E -1	2.44E -1	2.45E -1
2011.093	5-4 7	6.42E -7	3.36F -3	1.71E -1	1.71E -1	2.06E -1	2.06E -1
2015.009	5-4 6	7.58E -7	1.05E -3	1.80E -1	1.81E -1	2.98E -1	2.99E -1
2018.983	5-4 5	2.03E -6	1.64F -4	2.82E 0	2.82E 0	2.92E 0	2.92E 0
2022.724	5-4 4	3.32E -5	2.03F -4	4.88E -1	4.88E -1	5.49E -1	5.49E -1
2026.535	5-4 3	3.33E -6	6.78F -4	4.76E 0	4.76E 0	4.59E 0	4.59E 0
2030.310	5-4 2	4.62E -5	1.49E -4	1.90E -2	1.92E -2	3.42E -2	3.44E -2
2034.050	5-4 1	2.15E -5	1.98F -3	2.47E 0	2.47E 0	2.38E 0	2.38E 0

TABLE X

Calculated 4-3 Band Absorption Coefficients (in  $\text{km}^{-1}$ ) for  
Mid-latitude Summer Model at 3 km altitude

LYNE	IN	CO	CO2	H2O LORENTZ	TOTAL LORENTZ	H2O SUPER LORENTZ	TOTAL SUPER LORENTZ
1960.410	4-3	25	1.43E-10	2.98E-1	3.09E-1	4.17E-1	4.28E-1
1964.946	4-3	24	3.44E-10	3.92E-1	3.92E-1	6.21E-1	6.21E-1
1969.451	4-3	23	8.53E-10	3.51E-1	3.51E-1	5.43E-1	5.43E-1
1973.324	4-3	22	2.91E-9	4.42E-2	4.42E-2	9.40E-2	9.41E-2
1978.365	4-3	21	8.89E-9	3.26E-2	3.32E-2	7.06E-2	7.12E-2
1982.774	4-3	20	2.26E-8	5.82E-2	5.83E-2	1.05E-1	1.05E-1
1987.152	4-3	19	3.63E-8	4.37E-1	4.37E-1	6.17E-1	6.17E-1
1991.497	4-3	18	1.92E-7	6.16E-1	6.16E-1	7.51E-1	7.51E-1
1995.810	4-3	17	4.02E-7	1.27E-1	1.27E-1	2.38E-1	2.38E-1
2000.090	4-3	16	1.73E-6	1.96E-1	1.96E-1	2.62E-1	2.62E-1
2004.337	4-3	15	1.10E-5	3.24E-2	3.25E-2	6.47E-2	6.48E-2
2008.552	4-3	14	1.51E-4	1.57E-1	1.57E-1	2.19E-1	2.19E-1
2012.734	4-3	13	7.69E-4	7.44E-2	7.45E-2	1.22E-1	1.22E-1
2016.882	4-3	12	7.35E-4	6.16E-1	6.16E-1	7.82E-1	7.82E-1
2020.998	4-3	11	2.25E-3	9.60E-2	9.62E-2	1.61E-1	1.61E-1
2025.080	4-3	10	3.18E-3	4.43E-2	5.49E-2	8.96E-2	9.02E-2
2029.124	4-3	9	1.11E-3	2.01E-2	2.07E-2	3.89E-2	3.95E-2
2033.143	4-3	8	3.47E-3	1.76E-2	1.79E-2	3.24E-2	3.27E-2
2037.124	4-3	7	5.50E-3	5.92E-2	6.53E-2	8.03E-2	8.64E-2
2041.071	4-3	6	3.78E-3	2.31E-2	2.31E-2	2.51E-2	2.51E-2
2044.984	4-3	5	1.99E-3	8.72E-2	8.92E-2	1.30E-1	1.32E-1
2048.862	4-3	4	1.75E-3	2.41E-2	4.10E-2	3.50E-2	5.19E-2
2052.706	4-3	3	2.15E-3	8.90E-3	1.30E-2	1.73E-2	2.14E-2
2056.516	4-3	2	4.93E-3	0.28E-2	3.95E-2	1.95E-2	4.97E-2
2060.291	4-3	1	3.65E-3	1.64E-2	1.67E-2	1.63E-2	1.64E-2

TABLE XI  
Calculated 3-2 Band Absorption Coefficients (in  $\text{km}^{-1}$ ) for  
Mid-latitude Summer Model at 3 km Altitude

LTNE	IC	CO	CO <sub>2</sub>	H <sub>2</sub> O LORENTZ	TOTAL LORENTZ	H <sub>2</sub> O SUPER LORENTZ	TOTAL SUPER LORENTZ
1985.880	3-2 25	2.75E -6	1.75E -5	1.16E -1	1.16E -1	2.13E -1	2.13E -1
1990.452	3-2 24	1.35E -6	9.22E -6	6.40E -1	6.40E -1	1.03E 0	1.03E 0
1994.991	3-2 23	1.12E -6	4.30E -5	1.89E -1	1.89E -1	3.41E -1	3.41E -1
1999.499	3-2 22	1.27E -6	3.21E -5	4.39E -1	4.39E -1	5.36E -1	5.36E -1
2003.976	3-2 21	2.32E -6	8.90E -5	3.18E -2	3.27E -2	6.44E -2	6.53E -2
2008.420	3-2 20	2.11E -5	6.83E -5	1.84E -1	1.84E -1	2.48E -1	2.48E -1
2012.832	3-2 19	3.11E -5	4.23E -5	1.13E -1	1.13E -1	1.60E -1	1.60E -1
2017.212	3-2 18	2.45E -5	6.54E -5	3.09E 0	3.09E 0	3.67E 0	3.67E 0
2021.560	3-2 17	8.11E -5	5.15E -4	7.81E -2	7.81E -2	1.36E -1	1.37E -1
2025.875	3-2 16	6.08E -6	4.41E -4	1.33E -1	1.33E -1	1.74E -1	1.74E -1
2030.158	3-2 15	5.98E -6	3.50E -4	3.65E -2	3.69E -2	5.17E -2	5.17E -2
2034.408	3-2 14	6.84E -6	6.42E -4	9.67E -2	9.73E -2	1.12E -1	1.13E -1
2038.624	3-2 13	8.95E -6	2.77E -3	3.95E -2	4.24E -2	6.98E -2	7.26E -2
2042.808	3-2 12	1.46E -5	9.98E -3	1.61E -1	1.71E -1	2.41E -1	2.51E -1
2046.956	3-2 11	4.05E -5	2.47E -3	8.57E -2	8.82E -2	1.09E -1	1.12E -1
2051.075	3-2 10	4.67E -4	4.48E -3	6.38E -2	6.87E -2	7.02E -2	7.51E -2
2055.159	3-2 9	5.73E -4	3.62E -1	1.88E -2	3.81E -1	2.70E -2	3.90E -1
2059.209	3-2 8	1.13E -4	5.75E -3	6.53E -2	7.12E -2	9.10E -2	9.69E -2
2063.225	3-2 7	7.14E -5	1.14E -2	8.66E -2	9.61E -2	1.34E -1	1.45E -1
2067.206	3-2 6	6.35E -5	1.43E -2	6.85E -2	8.29E -2	1.10E -1	1.24E -1
2071.154	3-2 5	6.94E -5	4.04E -3	1.22E -2	1.63E -2	2.35E -2	2.76E -2
2075.063	3-2 4	9.29E -5	4.58E -3	3.60E -2	4.07E -2	5.15E -2	5.62E -2
2078.947	3-2 3	1.63E -4	1.04E -1	4.71E -2	1.50E -1	3.59E -2	1.59E -1
2082.792	3-2 2	4.49E -4	2.58E -3	1.02E -2	1.32E -2	1.70E -2	2.00E -2
2086.601	3-2 1	4.01E -3	1.82E -3	3.66E -2	4.20E -2	5.24E -2	5.82E -2

TABLE XII

Calculated 2-1 Band Absorption Coefficients (in  $\text{km}^{-1}$ ) for  
Mid-latitude Summer Model at 3 km Altitude

LINE	ID	CO	CO <sub>2</sub>	H <sub>2</sub> O LORENTZ	TOTAL LORENTZ	H <sub>2</sub> O SUPER LORENTZ	TOTAL SUPER LORENTZ
2011.419	2-1 25	1.02E -6	5.22E -5	4.54E -2	4.55E -2	8.62E -2	8.63E -2
2016.025	2-1 24	3.09E -6	9.01E -5	8.09E -1	8.09E -1	1.12E 0	1.12E 0
2020.600	2-1 23	2.44E -5	1.70E -4	2.91E -1	2.91E -1	3.58E -1	3.58E -1
2025.143	2-1 22	9.21E -5	3.03E -4	5.86E -2	5.96E -2	9.37E -2	9.41E -2
2029.655	2-1 21	7.83E -5	2.99E -4	2.33E -2	2.42E -2	4.06E -2	4.10E -2
2034.134	2-1 20	1.38E -5	8.62E -4	8.74E -1	8.74E -1	8.51E -1	8.52E -1
2039.581	2-1 19	9.46E -6	4.17E -3	3.89E -2	4.31E -2	6.87E -2	7.29E -2
2042.946	2-1 18	1.18E -5	7.62E -2	1.60E -1	2.36E -1	2.37E -1	3.13E -1
2047.379	2-1 17	1.05E -5	2.20E -2	3.39E -2	5.59E -2	5.28E -2	7.48E -2
2051.729	2-1 16	3.81E -5	7.25E -3	1.49E -1	1.54E -1	1.51E -1	1.58E -1
2056.047	2-1 15	9.33E -5	4.74E -3	1.56E -2	2.04E -2	2.48E -2	2.96E -2
2060.332	2-1 14	3.03E -4	6.28E -3	2.54E 0	2.55E 0	2.45E 0	2.46E 0
2064.583	2-1 13	2.05E -3	4.15E -2	1.36E 0	1.40E 0	1.62E 0	1.66E 0
2068.802	2-1 12	2.60E -2	1.14E -2	1.66E -2	5.76E -2	3.81E -2	7.55E -2
2072.988	2-1 11	1.92E -3	8.62E -3	4.04E -2	5.10E -2	5.48E -2	6.54E -2
2077.140	2-1 10	9.67E -4	5.45E -1	1.93E -2	5.65E -1	2.66E -2	5.73E -1
2081.258	2-1 9	1.35E -3	4.32E -3	1.49E -2	2.06E -2	2.22E -2	2.79E -2
2085.343	2-1 8	5.01E -4	8.02E -3	1.90E -2	2.75E -2	2.69E -2	3.94E -2
2089.394	2-1 7	4.37E -4	2.24E -3	1.52E -1	1.61E -1	2.11E -1	2.14E -1
2093.411	2-1 6	3.48E -4	2.02E -1	9.84E -2	3.02E -1	1.02E -1	3.05E -1
2097.696	2-1 5	3.32E -4	1.79E -3	2.74E 0	2.74E 0	2.63E 0	2.63E 0
2101.342	2-1 4	3.46E -4	4.00E -3	1.23E -2	1.66E -2	1.80E -2	2.23E -2
2105.256	2-1 3	3.83E -4	2.00E -3	1.34E -2	1.58E -2	1.93E -2	2.07E -2
2109.136	2-1 2	4.47E -4	7.95E -3	3.98E -3	1.24E -2	6.70E -3	1.51E -2
2112.981	2-1 1	5.74E -4	2.44E -3	8.57E -3	1.14E -2	1.44E -2	1.75E -2



TABLE XIII  
Calculated 1-0 Band Absorption Coefficients (in  $\text{km}^{-1}$ ) for  
Mid-latitude Summer Model at 3 km Altitude

LINE	I <sub>0</sub>	C <sub>0</sub>	C <sub>02</sub>	H <sub>2</sub> O LORENTZ	TOTAL LORENTZ	H <sub>2</sub> O SUPER LORENTZ	TOTAL SUPER LORENTZ
2037.026	1-0 25	4.55E -3	1.43E -2	4.50E -2	6.38E -2	6.60E -2	8.48E -2
2041.667	1-0 24	8.31E -3	4.30E -3	5.42E 0	5.42E 0	5.42E 0	5.43E 0
2046.277	1-0 23	1.05E -2	6.13E -3	2.33E -1	2.50E -1	2.54E -1	2.71E -1
2050.855	1-0 22	1.57E -2	1.06E -2	1.15E -2	3.78E -2	2.03E -2	4.66E -2
2055.401	1-0 21	2.24E -2	2.13E -2	8.03E -3	5.17E -2	1.69E -2	6.06E -2
2059.915	1-0 20	3.22E -2	7.33E -2	2.20E -1	3.25E -1	2.67E -1	3.72E -1
2064.398	1-0 19	4.40E -2	2.90E -1	5.80E -1	9.14E -1	7.65E -1	1.10E 0
2068.843	1-0 18	5.78E -2	1.42E -2	1.88E -2	9.38E -2	3.79E -2	1.12E -1
2073.266	1-0 17	7.95E -2	1.22E -2	5.81E -2	1.50E -1	7.32E -2	1.65E -1
2077.651	1-0 16	1.08E -1	4.14E -1	2.12E -2	5.38E -1	2.91E -2	5.46E -1
2082.003	1-0 15	1.20E -1	5.12E -3	4.24E -1	5.59E -1	4.11E -1	5.46E -1
2086.323	1-0 14	1.64E -1	5.68E -3	2.22E -2	1.92E -1	3.52E -2	2.05E -1
2090.610	1-0 13	1.89E -1	1.16E -3	2.33E -1	4.32E -1	2.98E -1	4.97E -1
2094.864	1-0 12	2.33E -1	7.47E -3	4.04E -2	2.61E -1	4.48E -2	2.85E -1
2099.064	1-0 11	2.68E -1	1.58E -3	9.23E -3	2.70E -1	1.48E -2	2.84E -1
2103.271	1-0 10	2.88E -1	8.85E -4	4.69E -2	3.46E -1	4.81E -2	3.47E -1
2107.425	1-0 9	3.23E -1	6.20E -3	1.85E -1	5.10E -1	1.82E -1	5.11E -1
2111.544	1-0 8	3.37E -1	2.42E -3	2.61E -2	3.66E -1	2.83E -2	3.68E -1
2115.630	1-0 7	3.41E -1	3.40E -3	5.79E -2	4.02E -1	7.70E -2	4.21E -1
2119.682	1-0 6	3.27E -1	1.22E -2	4.25E -3	3.43E -1	6.78E -3	3.46E -1

TABLE XIV  
Calculated 5-4 Band Absorption Coefficients (in  $\text{km}^{-1}$ ) for  
Mid-latitude Summer Model at 6 km Altitude

LINE	ID	CO	CO2	H2O LORENTZ	TOTAL LORENTZ	H2O SUPER LORENTZ	TOTAL SUPER LORENTZ
1957.199	5-4	20	3.57E -3	2.54E -2	2.90E -2	3.83E -2	4.19E -2
1961.541	5-4	19	1.13E -4	1.36E -1	1.36E -1	1.60E -1	1.60E -1
1965.851	5-4	18	4.81E -5	2.68E -1	2.68E -1	3.45E -1	3.45E -1
1970.129	5-4	17	1.01E -5	2.20E -2	2.30E -2	3.96E -2	4.06E -2
1974.374	5-4	16	1.70E -5	5.36E -3	5.36E -3	1.15E -2	1.15E -2
1978.584	5-4	15	2.79E -9	3.40E -3	3.47E -3	3.16E -3	3.23E -3
1982.764	5-4	14	6.83E -9	6.38E -3	6.39E -3	1.23E -2	1.23E -2
1986.913	5-4	13	1.37E -8	2.92E -2	2.93E -2	4.97E -2	4.98E -2
1991.024	5-4	12	3.19E -7	1.50E -1	1.50E -1	2.49E -1	2.49E -1
1995.107	5-4	11	2.41E -7	1.95E -2	1.96E -2	3.82E -2	3.83E -2
1999.154	5-4	10	4.10E -5	3.07E -1	3.07E -1	3.20E -1	3.20E -1
2003.167	5-4	9	7.66E -7	0.14E -3	4.19E -3	6.42E -3	6.47E -3
2007.147	5-4	8	3.00E -7	1.82E -2	1.92E -2	2.61E -2	2.71E -2
2011.093	5-4	7	2.48E -7	2.92E -2	2.92E -2	3.32E -2	3.32E -2
2015.005	5-4	6	2.89E -7	1.64E -2	1.90E -2	3.33E -2	3.39E -2
2019.883	5-4	5	7.00E -7	3.00E -1	3.00E -1	3.26E -1	3.26E -1
2022.724	5-4	4	1.09E -5	4.40E -2	4.41E -2	6.37E -2	6.38E -2
2026.535	5-4	3	1.27E -6	6.87E -1	6.87E -1	6.63E -1	6.63E -1
2030.310	5-4	2	1.27E -6	1.60E -3	1.95E -3	3.75E -3	3.82E -3
2034.050	5-4	1	1.01E -5	3.22E -1	3.23E -1	3.68E -1	3.69E -1

TABLE XV  
Calculated 4-3 Band Absorption Coefficients (in  $\text{km}^{-1}$ ) for  
Mid-latitude Summer Model at 6 km Altitude

LINE	$I_0$	$C_0$	$C_0^2$	H <sub>2</sub> O LORENTZ	TOTAL LORENTZ	H <sub>2</sub> O SUPER LORENTZ	TOTAL SUPER LORENTZ
1960.410	4-3 25	4.54E-11	9.57E-23	3.31E-2	4.27E-2	5.03E-2	5.99E-2
1964.944	4-3 24	1.09E-10	1.06E-20	4.30E-2	4.31E-2	7.39E-2	7.40E-2
1969.451	4-3 23	2.73E-10	3.04E-20	5.72E-2	3.72E-2	6.28E-2	6.28E-2
1973.924	4-3 22	9.33E-10	2.36E-20	4.91E-3	4.93E-3	1.13E-2	1.13E-2
1974.365	4-3 21	2.87E-9	2.76E-20	3.61E-3	3.89E-3	8.44E-3	8.72E-3
1982.774	4-3 20	6.83E-9	1.06E-20	6.38E-3	6.39E-3	1.23E-2	1.23E-2
1987.152	4-3 19	1.18E-8	4.62E-20	4.87E-2	4.67E-2	7.27E-2	7.27E-2
1991.497	4-3 18	6.87E-8	7.99E-20	6.78E-1	6.78E-1	8.93E-1	8.93E-1
1995.910	4-3 17	1.84E-7	2.59E-20	1.38E-2	1.38E-2	2.81E-2	2.81E-2
2000.090	4-3 16	6.80E-7	4.30E-20	2.38E-2	2.38E-2	3.36E-2	3.36E-2
2004.337	4-3 15	6.11E-6	1.89E-20	3.27E-3	3.30E-3	7.30E-3	7.33E-3
2008.552	4-3 14	5.14E-5	6.98E-20	1.63E-2	1.64E-2	2.46E-2	2.47E-2
2012.734	4-3 13	3.17E-6	2.12E-20	8.38E-3	8.40E-3	1.42E-2	1.42E-2
2016.882	4-3 12	3.31E-6	1.44E-20	9.64E-3	9.64E-3	9.28E-3	9.28E-3
2020.996	4-3 11	9.07E-6	9.03E-20	1.04E-2	1.04E-2	1.83E-2	1.84E-2
2025.080	4-3 10	1.90E-4	1.18E-20	5.62E-3	5.92E-3	1.01E-2	1.04E-2
2029.128	4-3 9	5.15E-5	2.24E-20	2.23E-3	2.51E-3	4.59E-3	4.87E-3
2033.143	4-3 8	1.56E-5	9.21E-20	1.65E-3	1.76E-3	3.39E-3	3.50E-3
2037.124	4-3 7	2.10E-4	3.27E-20	5.65E-3	9.13E-3	8.37E-3	1.18E-2
2041.071	4-3 6	1.53E-5	8.12E-20	2.27E-1	2.30E-1	2.67E-1	2.68E-1
2044.984	4-3 5	8.59E-6	8.78E-20	9.67E-3	1.06E-2	1.55E-2	1.54E-2
2048.862	4-3 4	7.72E-6	8.05E-20	2.14E-3	1.02E-2	3.46E-3	1.15E-2
2052.704	4-3 3	9.44E-6	1.99E-20	8.73E-4	2.67E-3	1.86E-3	3.86E-3
2056.516	4-3 2	2.17E-5	1.57E-20	9.64E-4	1.67E-2	2.19E-3	1.79E-2
2060.291	4-3 1	1.54E-4	3.58E-20	1.92E-1	1.94E-1	1.97E-1	2.01E-1

TABLE XVI  
Calculated 3-2 Band Absorption Coefficients (in  $\text{km}^{-1}$ ) for  
Mid-latitude Summer Model at 6 km Altitude

LTNE	IQ	CO	CO <sub>2</sub>	H <sub>2</sub> O LORENTZ	TOTAL LORENTZ	H <sub>2</sub> O SUPER LORENTZ	TOTAL SUPER LORENTZ
1985.860	3-2 25	9.95E -7	7.88E -6	1.23E -2	1.23E -2	2.45E -2	2.45E -2
1990.452	3-2 24	4.80E -7	3.70E -6	6.95E -2	6.95E -2	1.21E -1	1.21E -1
1994.991	3-2 23	4.08E -7	1.78E -5	2.07E -2	2.07E -2	4.04E -2	4.04E -2
1999.499	3-2 22	4.67E -7	1.33E -5	5.44E -2	5.44E -2	7.10E -2	7.10E -2
2003.974	3-2 21	9.40E -7	5.29E -4	3.23E -3	3.76E -3	7.32E -3	7.85E -3
2008.420	3-2 20	6.64E -6	3.27E -5	1.86E -2	1.86E -2	2.73E -2	2.73E -2
2012.832	3-2 19	1.57E -5	2.03E -5	1.72E -2	1.72E -2	2.27E -2	2.27E -2
2017.212	3-2 18	1.17E -5	3.24E -5	3.25E -1	3.23E -1	4.15E -1	4.15E -1
2021.560	3-2 17	3.54E -6	2.81E -4	7.68E -3	7.94E -3	1.46E -2	1.49E -2
2025.875	3-2 16	2.64E -6	3.36E -4	1.50E -2	1.53E -2	2.08E -2	2.11E -2
2030.158	3-2 15	2.60E -6	2.36E -4	3.79E -3	4.03E -3	5.62E -3	5.86E -3
2034.408	3-2 14	2.07E -6	4.55E -4	9.90E -3	1.04E -2	1.19E -2	1.24E -2
2038.624	3-2 13	3.04E -6	1.13E -3	3.87E -3	5.00E -3	7.46E -3	8.59E -3
2042.808	3-2 12	6.05E -6	4.42E -3	1.67E -2	2.11E -2	2.70E -2	3.14E -2
2046.958	3-2 11	1.62E -5	1.15E -3	7.88E -3	9.02E -3	1.10E -2	1.22E -2
2051.074	3-2 10	1.83E -4	2.20E -3	1.03E -2	1.32E -2	1.14E -2	1.38E -2
2055.159	3-2 9	2.36E -4	3.20E -3	2.07E -3	3.23E -3	3.90E -3	3.24E -3
2059.209	3-2 8	4.79E -5	2.95E -3	7.33E -3	1.04E -2	1.08E -2	1.38E -2
2063.225	3-2 7	3.14E -5	6.07E -3	8.50E -3	1.46E -2	1.45E -2	2.06E -2
2067.204	3-2 6	2.87E -5	7.21E -3	6.73E -3	1.40E -2	1.15E -2	1.87E -2
2071.154	3-2 5	3.19E -5	2.02E -3	1.25E -3	3.30E -3	2.59E -3	4.64E -3
2075.058	3-2 4	4.31E -5	2.51E -3	3.88E -3	6.23E -3	5.97E -3	8.32E -3
2078.947	3-2 3	7.64E -5	7.72E -2	3.94E -3	8.12E -2	5.12E -3	8.24E -2
2082.792	3-2 2	2.13E -4	1.25E -3	9.71E -4	2.43E -3	1.74E -3	3.20E -3
2086.501	3-2 1	1.06E -3	8.66E -4	3.12E -3	5.95E -3	4.93E -3	7.76E -3

TABLE XVII  
Calculated 2-1 Band Absorption Coefficients (in  $\text{km}^{-1}$ ) for  
Mid-latitude Summer Model at 6 km Altitude

LINE	I	CO	CO <sub>2</sub>	H <sub>2</sub> O LORENTZ	TOTAL LORENTZ	H <sub>2</sub> O SUPER LORENTZ	TOTAL SUPER LORENTZ
2011.419	2-1 25	4.00E -7	2.49E -5	4.71E -3	4.74E -3	9.74E -3	9.77E -3
2014.025	2-1 24	1.28E -6	4.66E -5	8.45E -2	8.45E -2	1.27E -1	1.27E -1
2020.600	2-1 23	1.00E -5	6.35E -5	3.64E -2	3.65E -2	4.45E -2	4.46E -2
2025.143	2-1 22	4.35E -5	1.82E -4	6.03E -3	6.20E -3	1.05E -2	1.07E -2
2029.555	2-1 21	4.17E -5	1.15E -4	2.52E -3	2.68E -3	4.64E -3	4.80E -3
2034.134	2-1 20	6.27E -5	3.43E -4	8.89E -2	8.92E -2	8.69E -2	8.72E -2
2038.581	2-1 19	4.07E -5	1.71E -3	3.80E -3	5.51E -3	7.35E -3	9.06E -3
2042.396	2-1 18	4.08E -5	4.82E -2	1.71E -2	6.53E -2	2.71E -2	7.53E -2
2047.379	2-1 17	7.07E -5	1.05E -2	3.20E -3	1.33E -2	5.59E -3	1.61E -2
2051.729	2-1 16	1.56E -5	3.49E -3	1.67E -2	2.02E -2	1.79E -2	2.05E -2
2056.047	2-1 15	3.86E -5	2.37E -3	1.46E -3	3.87E -3	2.56E -3	4.37E -3
2060.332	2-1 14	1.09E -4	3.25E -3	2.88E -1	4.01E -1	2.95E -1	2.99E -1
2064.583	2-1 13	9.03E -4	2.34E -2	1.34E -1	1.58E -1	1.73E -1	1.97E -1
2068.802	2-1 12	1.06E -2	6.02E -3	1.89E -3	2.25E -2	4.00E -3	2.46E -2
2072.988	2-1 11	8.33E -4	4.00E -3	4.64E -3	9.51E -3	6.67E -3	1.15E -2
2077.140	2-1 10	4.71E -4	3.95E -1	1.67E -3	6.01E -1	2.55E -3	4.02E -1
2081.259	2-1 9	7.65E -4	2.00E -3	1.45E -3	4.21E -3	2.32E -3	5.10E -3
2085.343	2-1 8	2.66E -4	4.48E -3	1.79E -3	6.53E -3	2.65E -3	7.59E -3
2089.394	2-1 7	2.04E -4	1.00E -3	1.40E -2	1.57E -2	2.95E -2	2.22E -2
2093.411	2-1 6	1.72E -4	1.40E -1	9.50E -3	1.51E -1	1.70E -2	1.70E -1
2097.394	2-1 5	1.69E -4	7.92E -4	4.83E -1	4.84E -1	4.63E -1	4.64E -1
2101.342	2-1 4	1.79E -4	2.07E -3	1.20E -3	3.53E -3	2.01E -3	4.26E -3
2105.256	2-1 3	1.09E -4	8.40E -4	1.64E -3	2.67E -3	2.35E -3	3.39E -3
2109.136	2-1 2	2.35E -4	4.57E -3	3.68E -4	5.17E -4	6.82E -4	5.40E -4
2112.981	2-1 1	5.06E -4	1.06E -3	7.20E -4	2.07E -3	1.34E -3	2.38E -3

TABLE XVIII  
Calculated 1-0 Band Absorption Coefficients (in  $\text{km}^{-1}$ ) for  
Mid-latitude Summer Model at 6 km Altitude

LINE	IN	CO	CO <sub>2</sub>	H <sub>2</sub> O LORENTZ	TOTAL LORENTZ	H <sub>2</sub> O SUPER LORENTZ	TOTAL SUPER LORENTZ
2037.026	1-0 25	3.22E -3	9.79E -3	4.32E -3	1.73E -2	6.91E -3	1.39E -2
2041.667	1-0 24	6.10E -3	1.51E -3	5.55E -3	5.63E -3	5.75E -3	5.83E -3
2046.277	1-0 23	7.02E -3	2.76E -3	2.15E -2	3.22E -2	2.52E -2	3.59E -2
2050.955	1-0 22	1.02E -2	5.15E -3	1.13E -3	1.85E -2	2.18E -3	1.95E -2
2055.401	1-0 21	1.00E -2	1.09E -2	8.25E -4	2.97E -2	1.07E -3	3.02E -2
2059.915	1-0 20	2.66E -2	4.06E -2	2.45E -2	9.19E -2	3.20E -2	9.94E -2
2064.598	1-0 19	3.75E -2	2.48E -1	5.68E -2	3.42E -1	8.13E -2	3.67E -1
2068.042	1-0 18	5.02E -2	7.73E -3	1.94E -3	4.19E -2	4.01E -3	6.39E -2
2072.266	1-0 17	7.12E -2	6.21E -3	6.07E -3	8.35E -2	8.15E -3	8.56E -2
2077.651	1-0 16	9.47E -2	3.72E -1	1.94E -3	4.62E -1	2.88E -3	4.70E -1
2082.003	1-0 15	1.02E -1	2.46E -3	4.59E -2	1.70E -1	4.45E -2	1.59E -1
2086.323	1-0 14	1.57E -1	2.93E -3	1.03E -3	1.62E -1	3.35E -3	1.63E -1
2090.610	1-0 13	1.03E -1	4.78E -4	2.20E -2	2.14E -1	3.03E -2	2.24E -1
2094.864	1-0 12	2.31E -1	3.47E -3	4.33E -3	2.36E -1	4.85E -3	2.39E -1
2099.084	1-0 11	2.76E -1	6.22E -4	9.45E -4	2.72E -1	1.64E -3	2.72E -1
2103.271	1-0 10	3.05E -1	3.65E -4	7.07E -3	3.12E -1	7.16E -3	3.13E -1
2107.425	1-0 9	3.35E -1	2.76E -3	1.62E -2	3.54E -1	1.62E -2	3.54E -1
2111.544	1-0 8	3.54E -1	1.02E -3	2.54E -3	3.58E -1	2.78E -3	3.58E -1
2115.630	1-0 7	3.62E -1	1.57E -3	4.98E -3	3.60E -1	7.18E -3	3.71E -1
2119.682	1-0 6	3.50E -1	6.28E -3	3.95E -4	3.57E -1	6.87E -4	3.57E -1



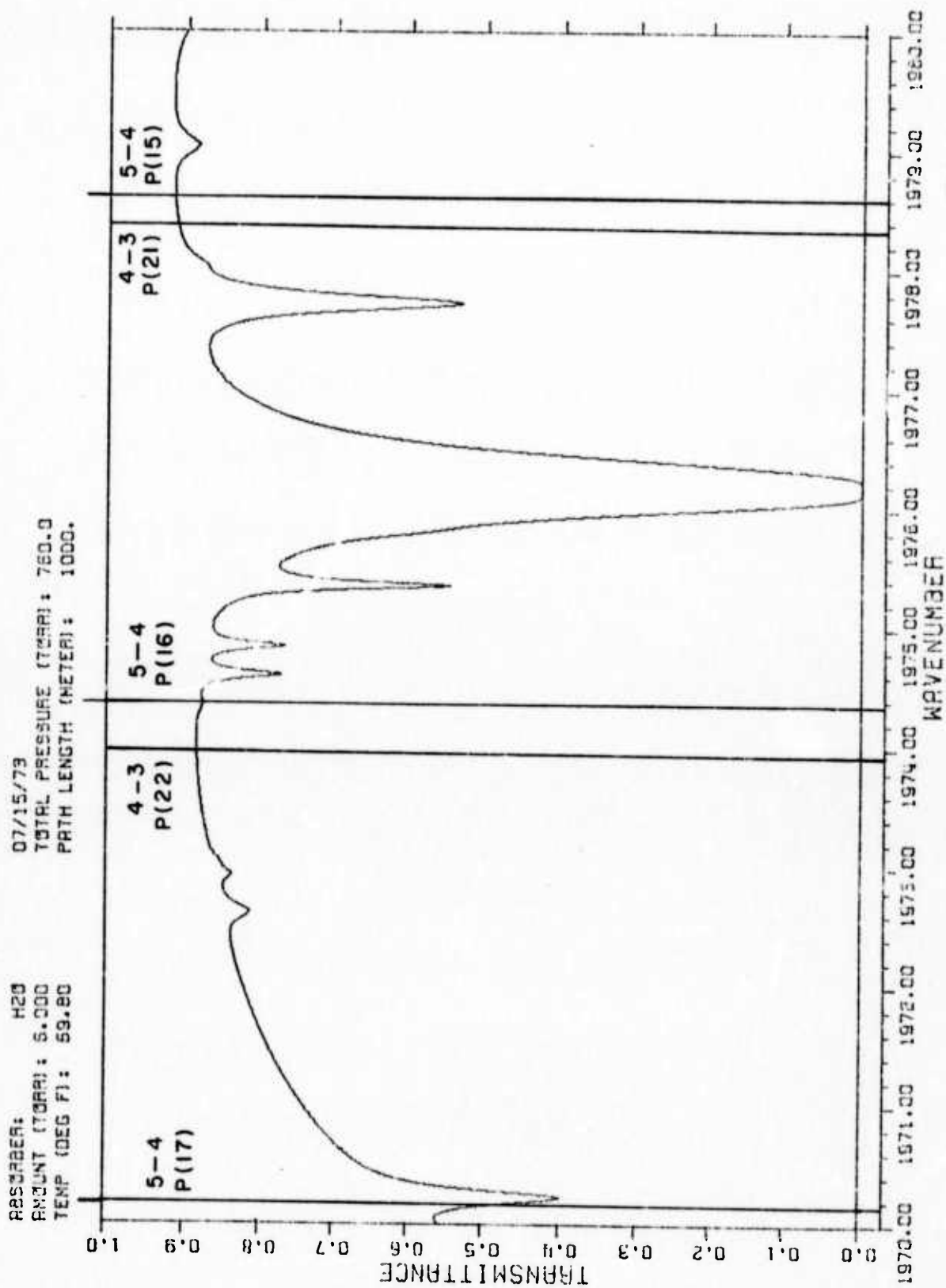


FIG. 1



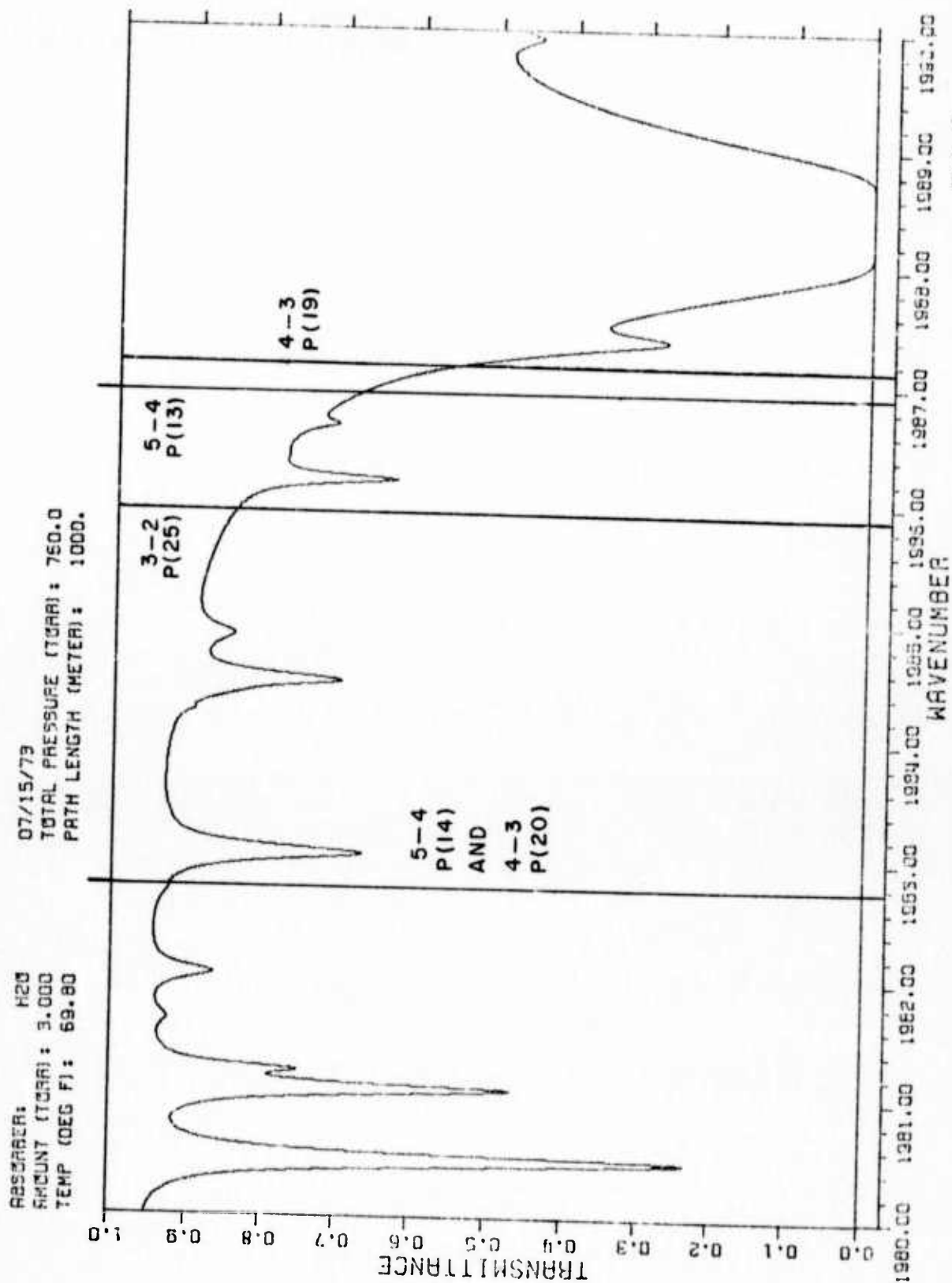


FIG. 2

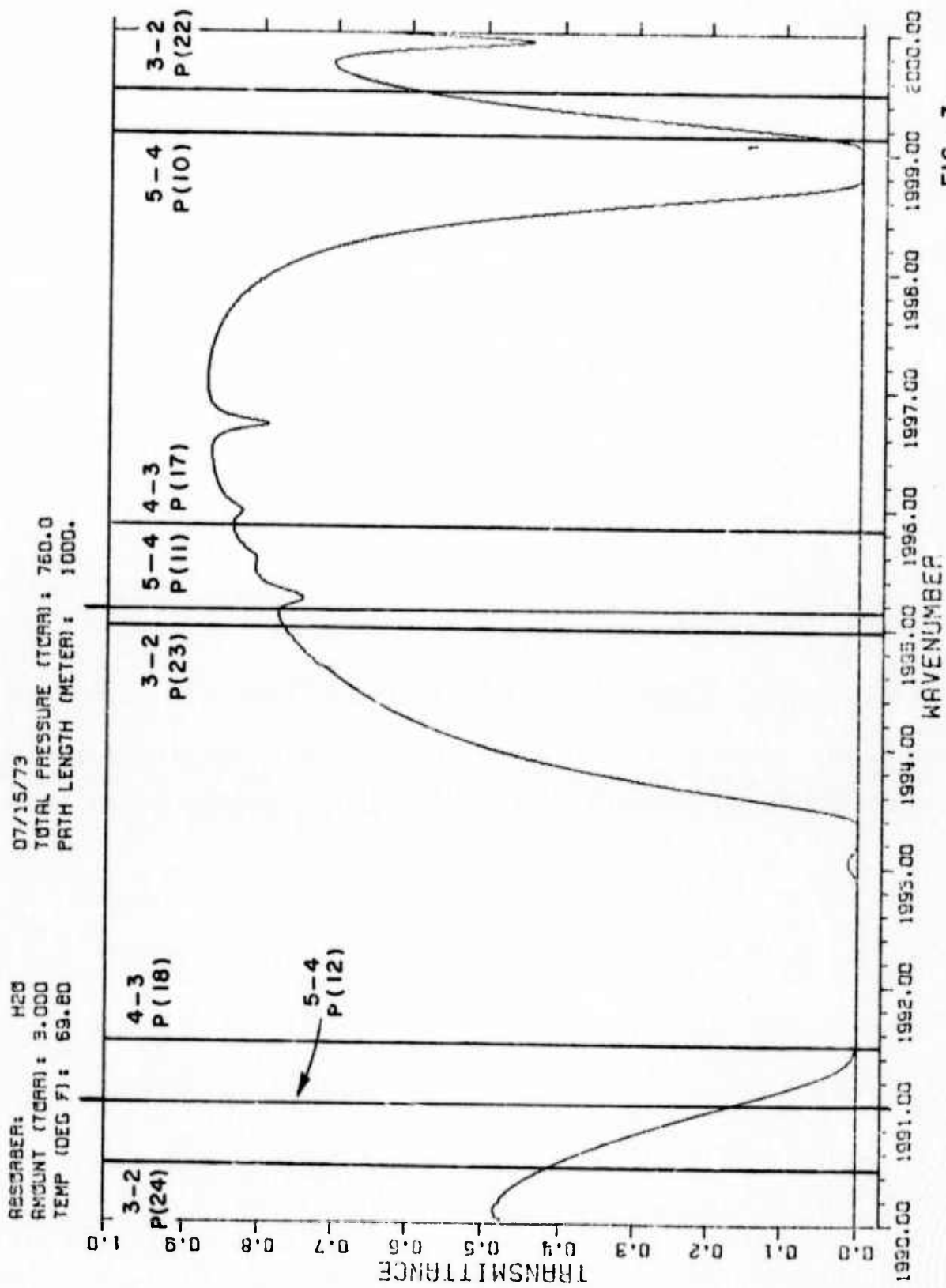


FIG. 3

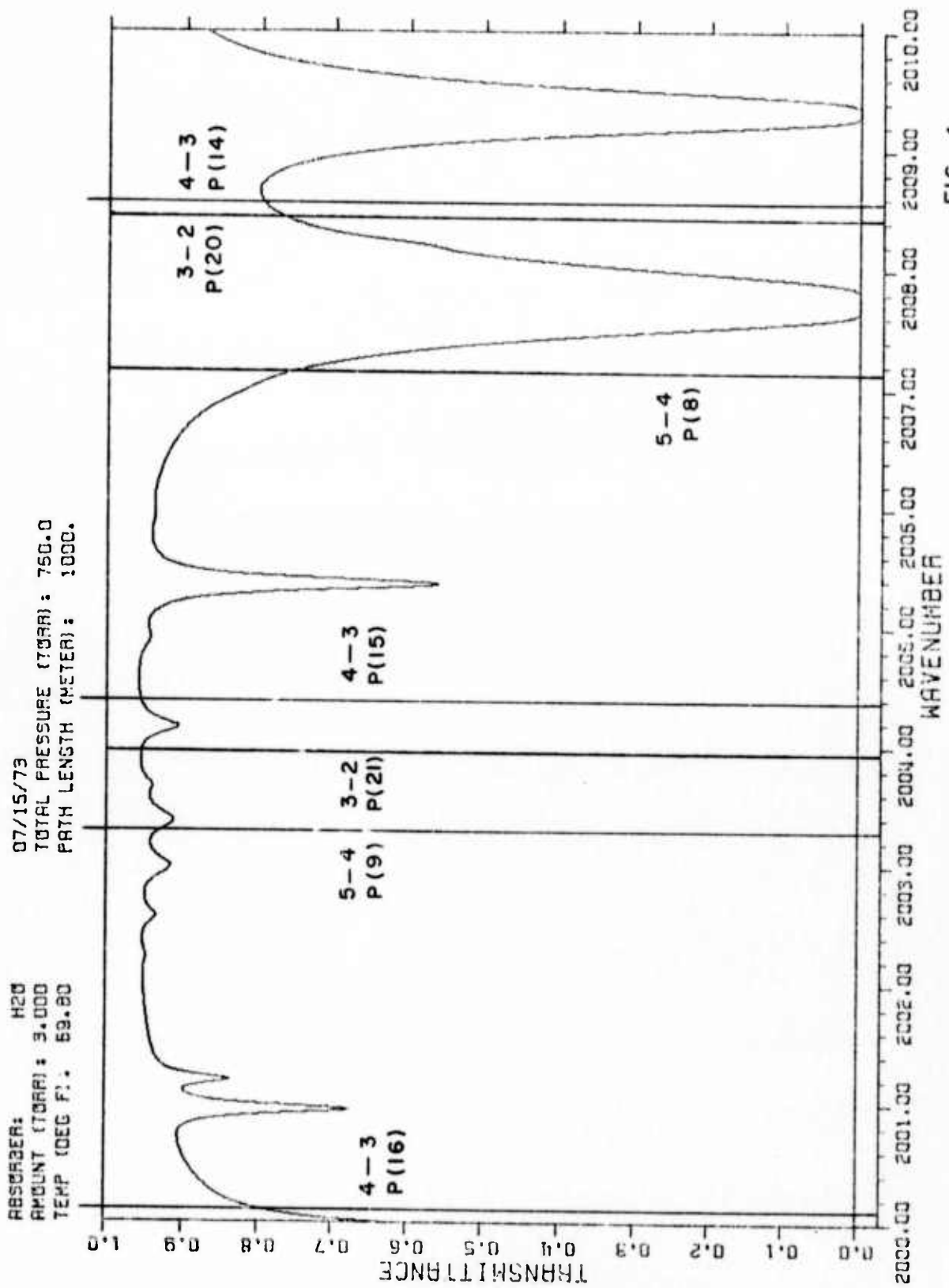


FIG. 4

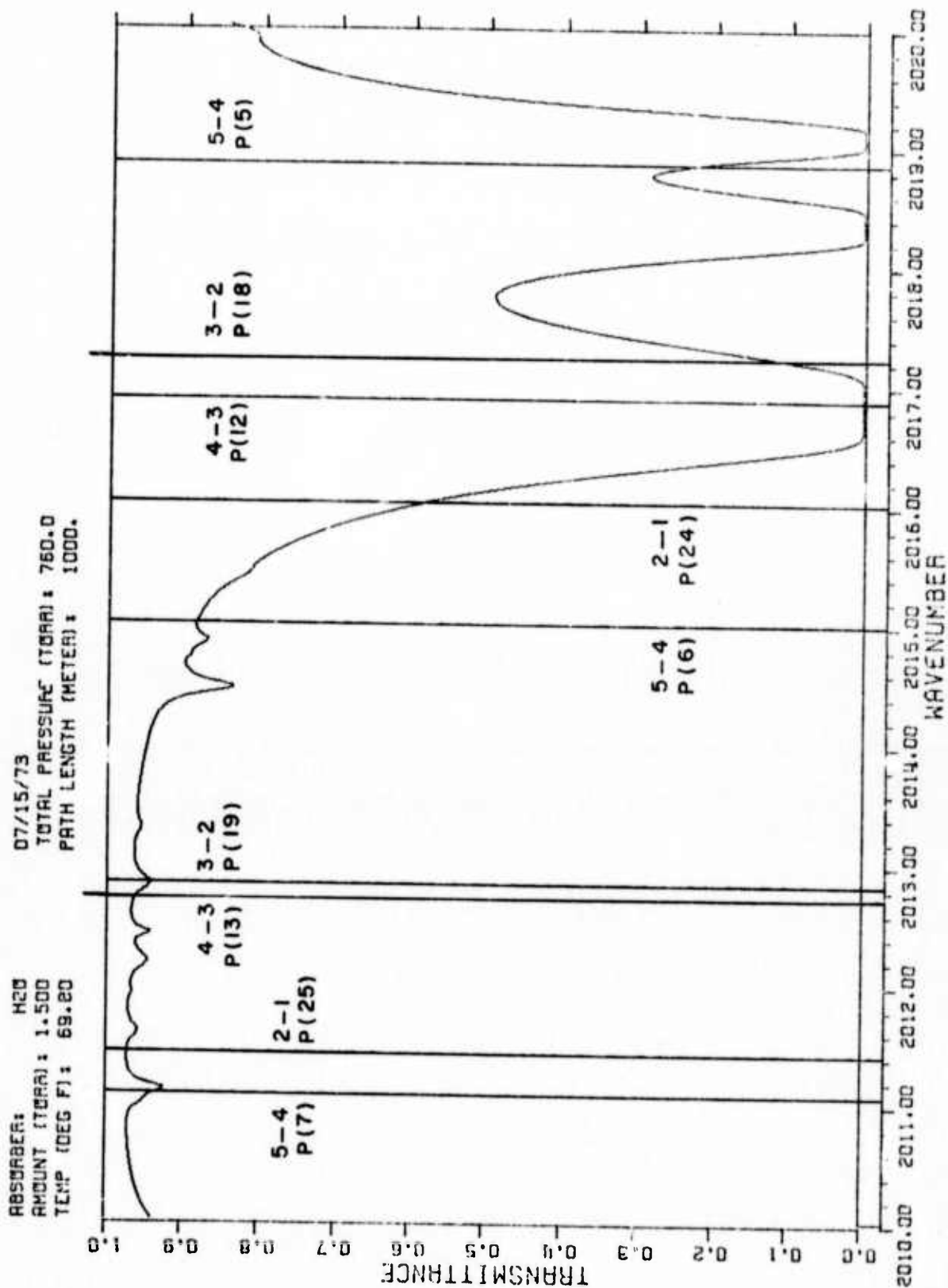


FIG. 5

ABSORBER: H<sub>2</sub>O  
AMOUNT (TORR): 3.000  
TEMP (DEG F): 59.60

07/15/73  
TOTAL PRESSURE (TORR): 760.0  
PATH LENGTH (METER): 1000.

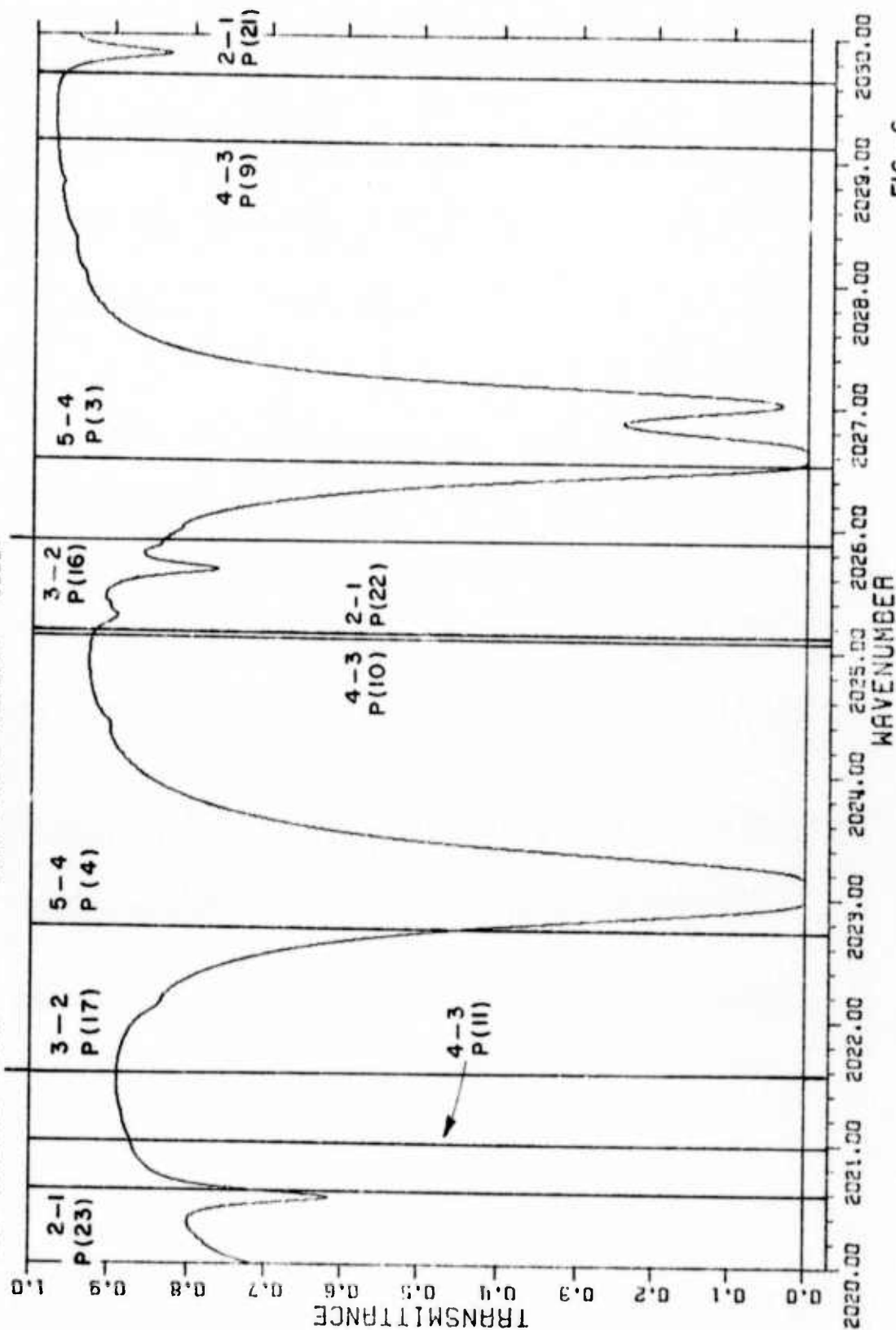


FIG. 6

ABSORBER: H<sub>2</sub>O  
 AMOUNT (TORR): 5.000  
 TEMP (DEG F): 59.80  
 07/15/73  
 TOTAL PRESSURE (TORR): 760.0  
 PATH LENGTH (METER): 1000.

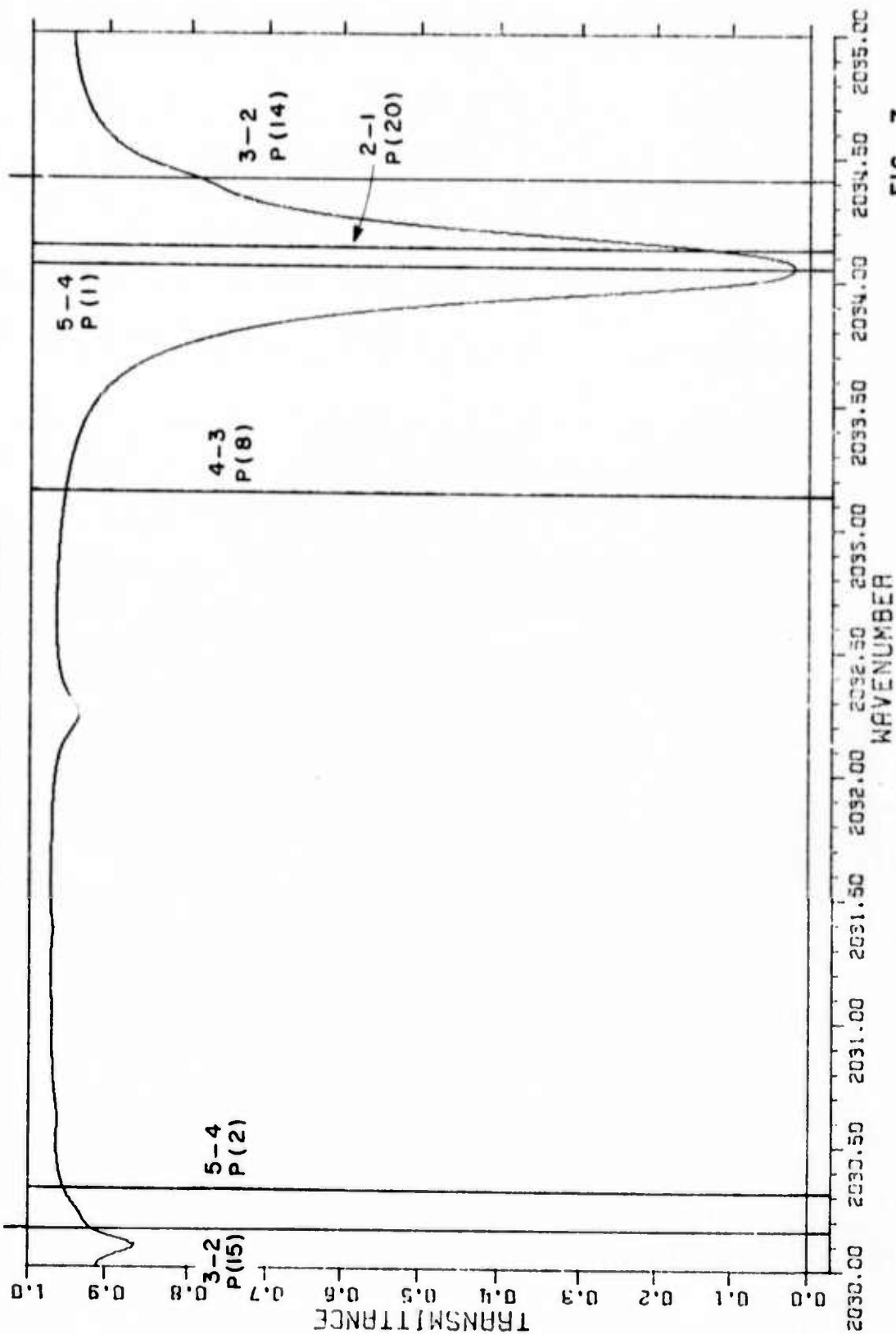


FIG. 7

ABSORBER: H<sub>2</sub>O  
 AMOUNT (TORR): 10.00  
 TEMP (DEG F): 59.80

07/10/73  
 TOTAL PRESSURE (TORR): 760.0  
 PATH LENGTH (METER): 1000.

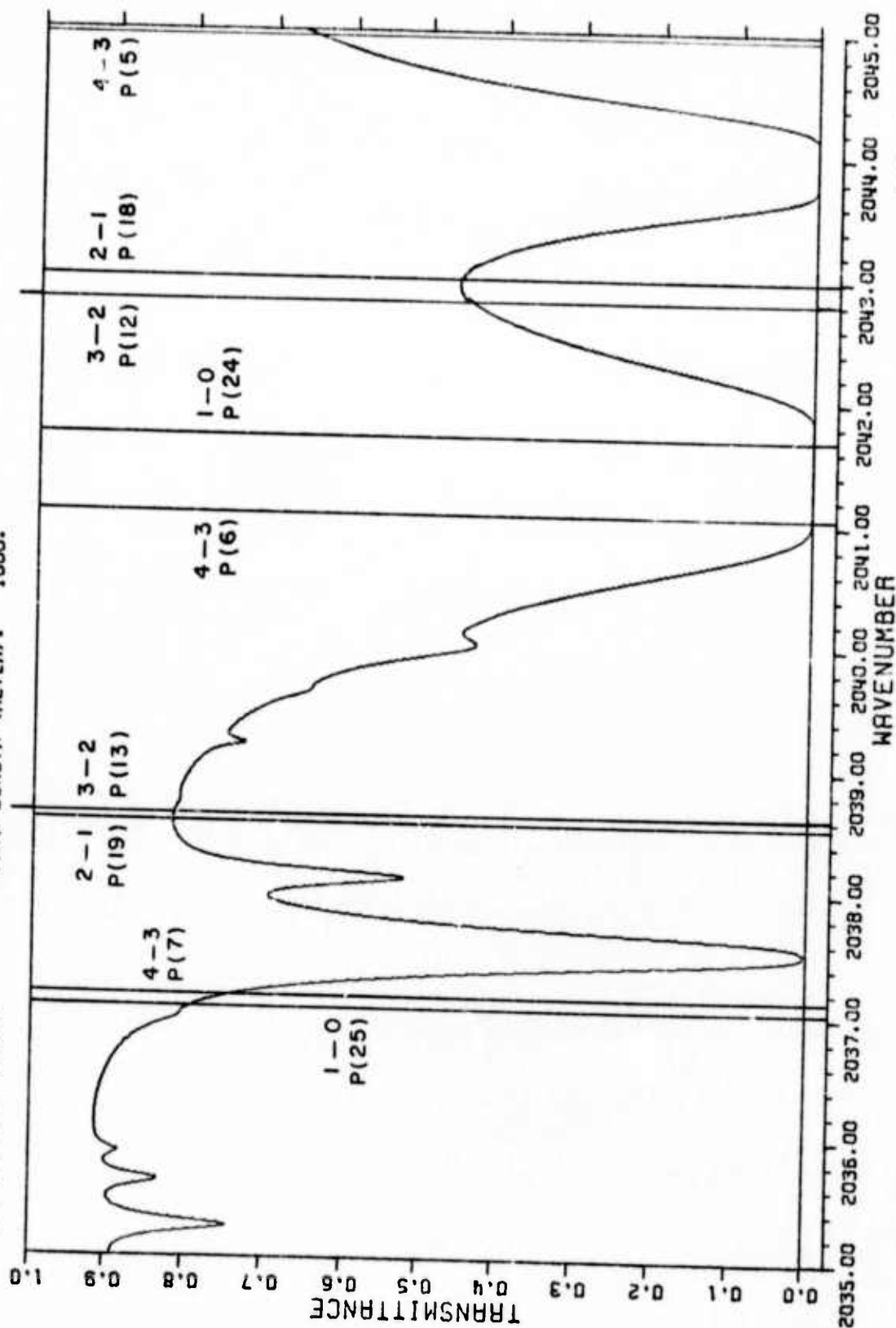


FIG. 8



ABSORBER: H<sub>2</sub>O  
 AMOUNT (TORR): 10.00  
 TEMP (DEG F): 69.80

07/10/73

TOTAL PRESSURE (TORR): 760.0  
 PATH LENGTH (METER): 1000.

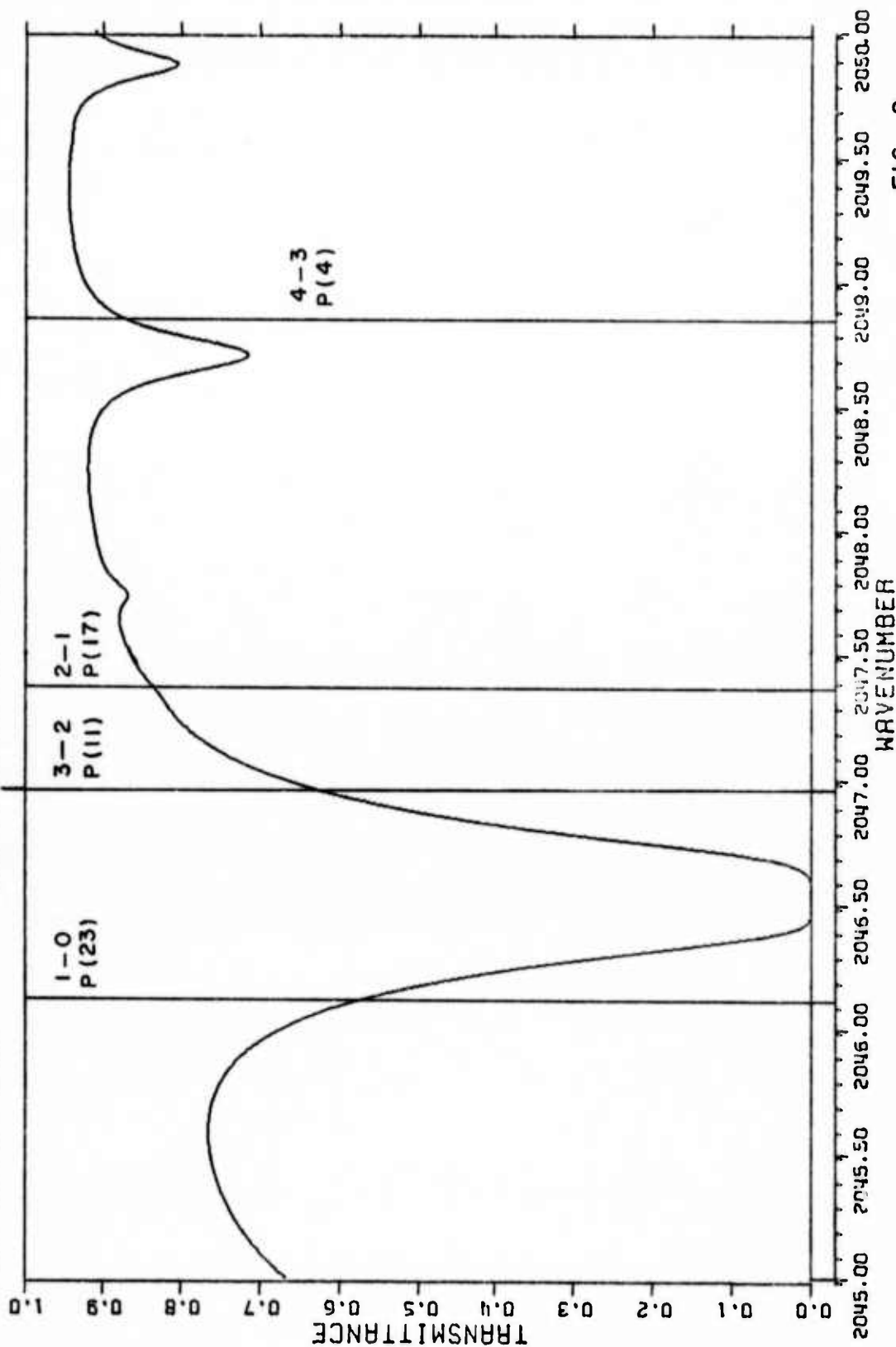


FIG. 9

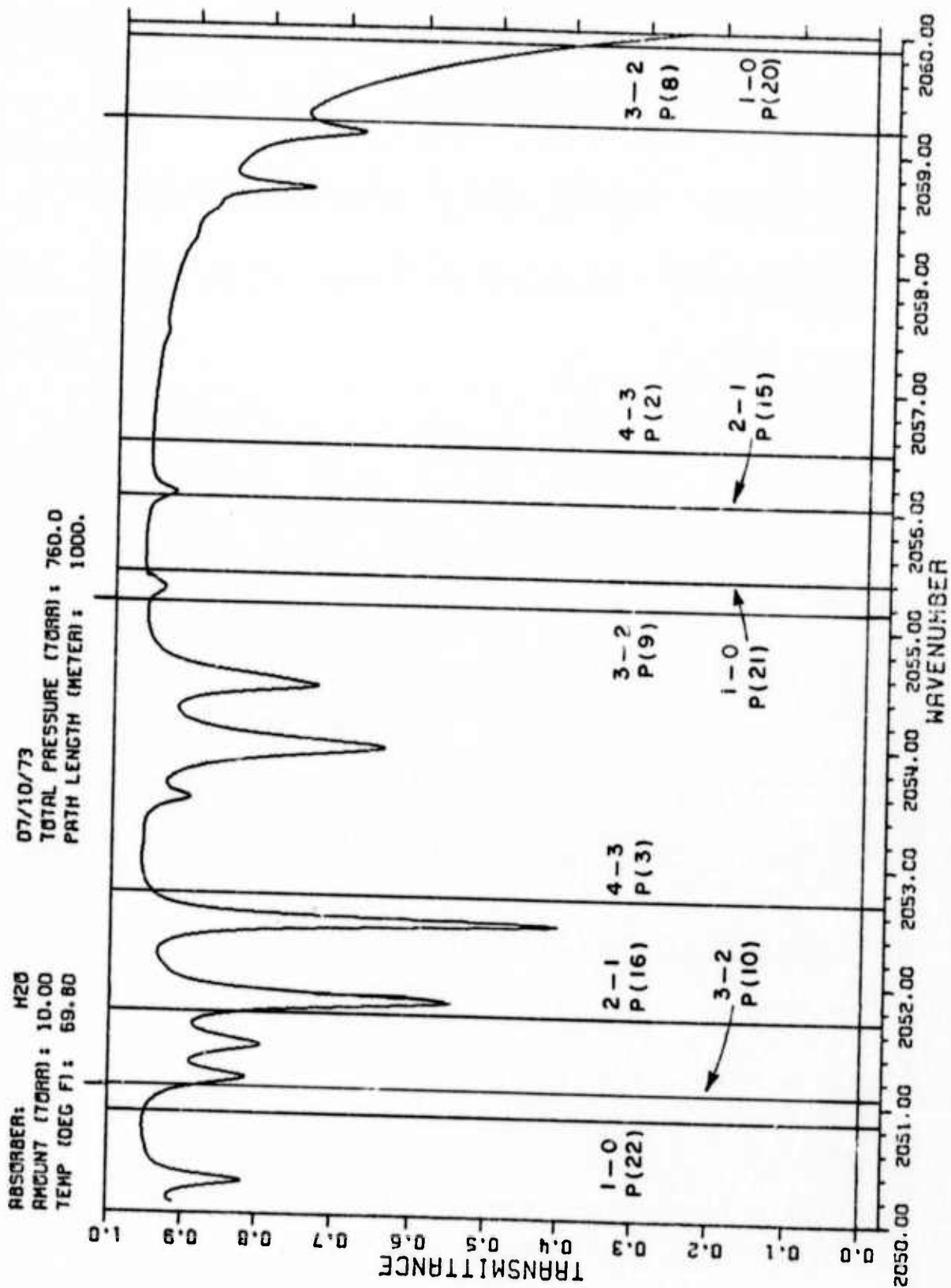


FIG. 10

ABSORBER: H<sub>2</sub>O  
 AMOUNT (TCRA): 1.000  
 TEMP (DEG F): 69.90

07/11/79  
 TOTAL PRESSURE (TCRA): 760.0  
 PATH LENGTH (METER): 1000.

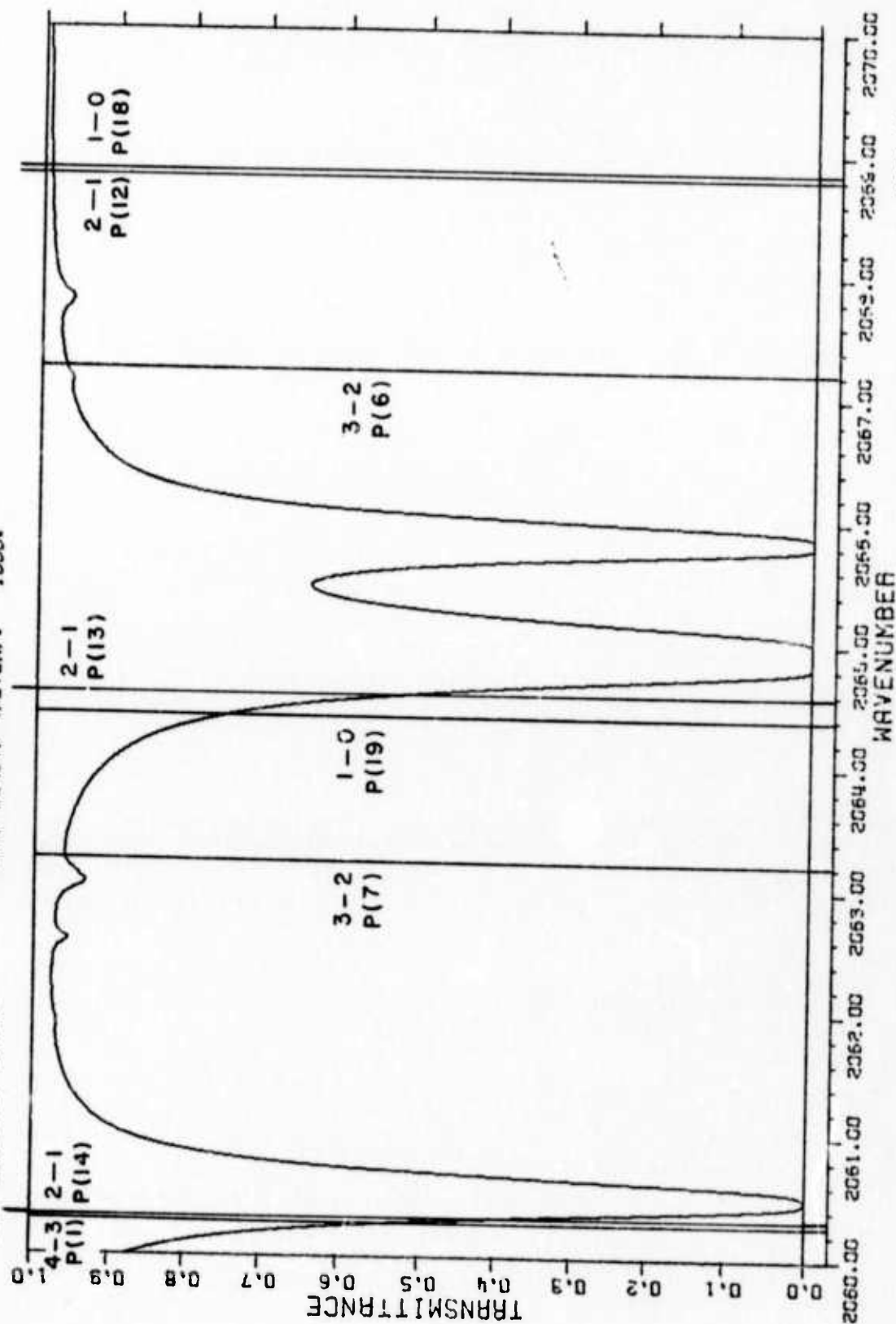


FIG. 11

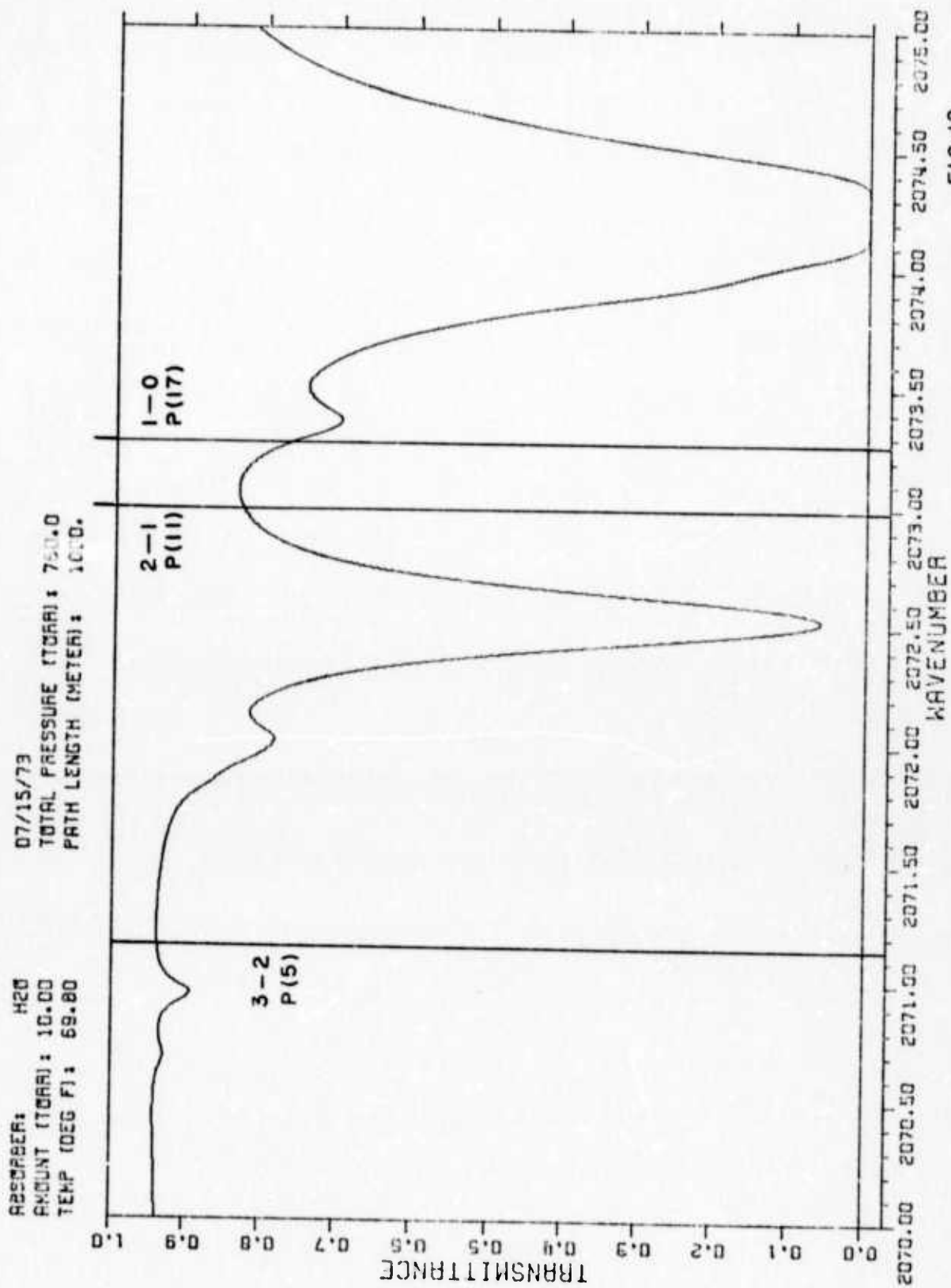


FIG.12

ABSORBER: H<sub>2</sub>O  
AMOUNT (TORR): 10.00  
TEMP (DEG F): 69.90

07/10/73  
TOTAL PRESSURE (TORR): 760.0  
PATH LENGTH (METER): 1000.

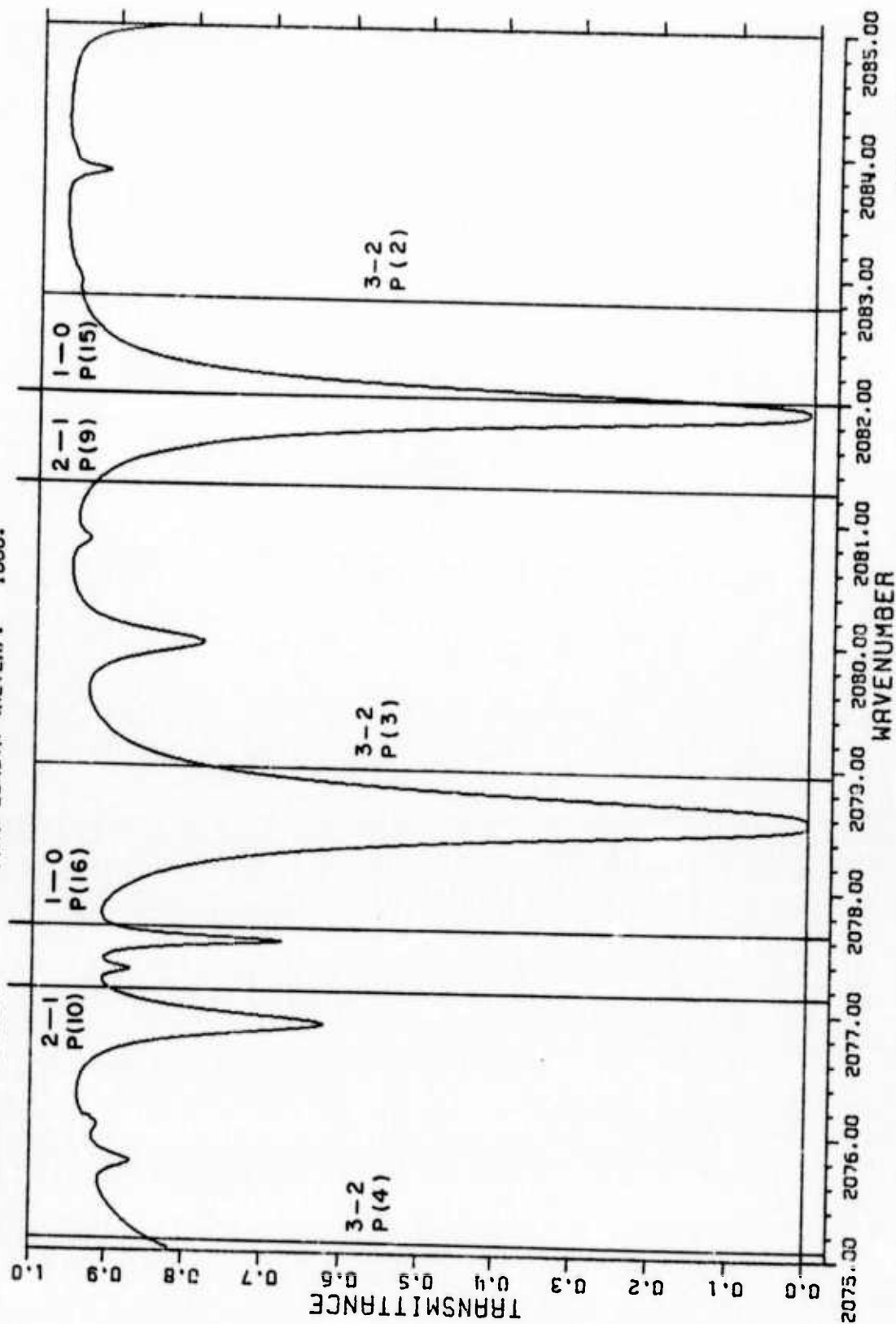


FIG. 13

ABSORBER: H<sub>2</sub>O  
AMOUNT (TORR): 10.00  
TEMP (DEG F): 69.80

07/10/73  
TOTAL PRESSURE (TORR): 760.0  
PATH LENGTH (METER): 1000.

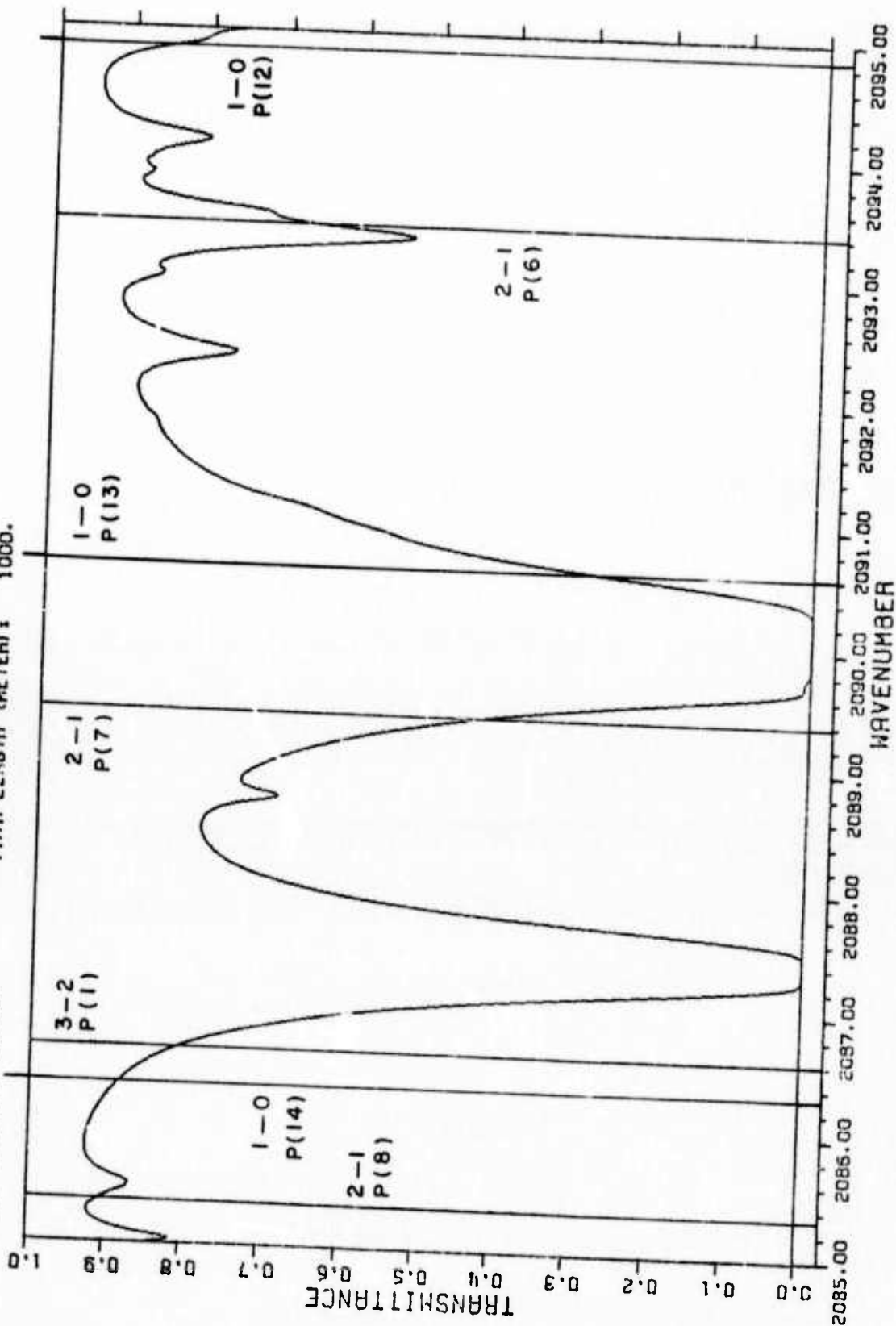


FIG. 14

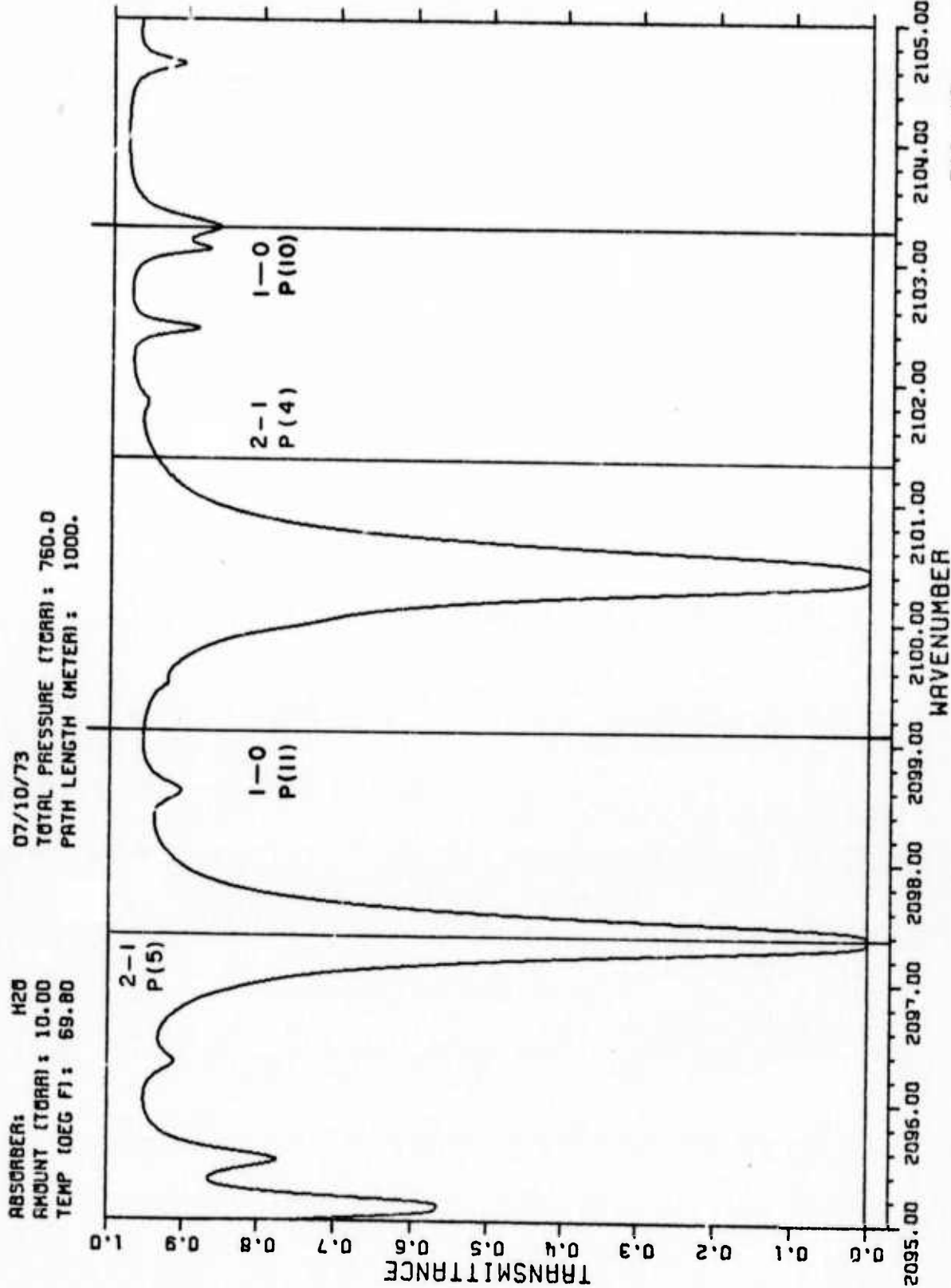


FIG. 15



ABSORBER: H<sub>2</sub>O  
AMOUNT (TORR): 10.00  
TEMP (DEG F): 59.80

07/10/73  
TOTAL PRESSURE (TORR): 760.0  
PATH LENGTH (METER): 1000.

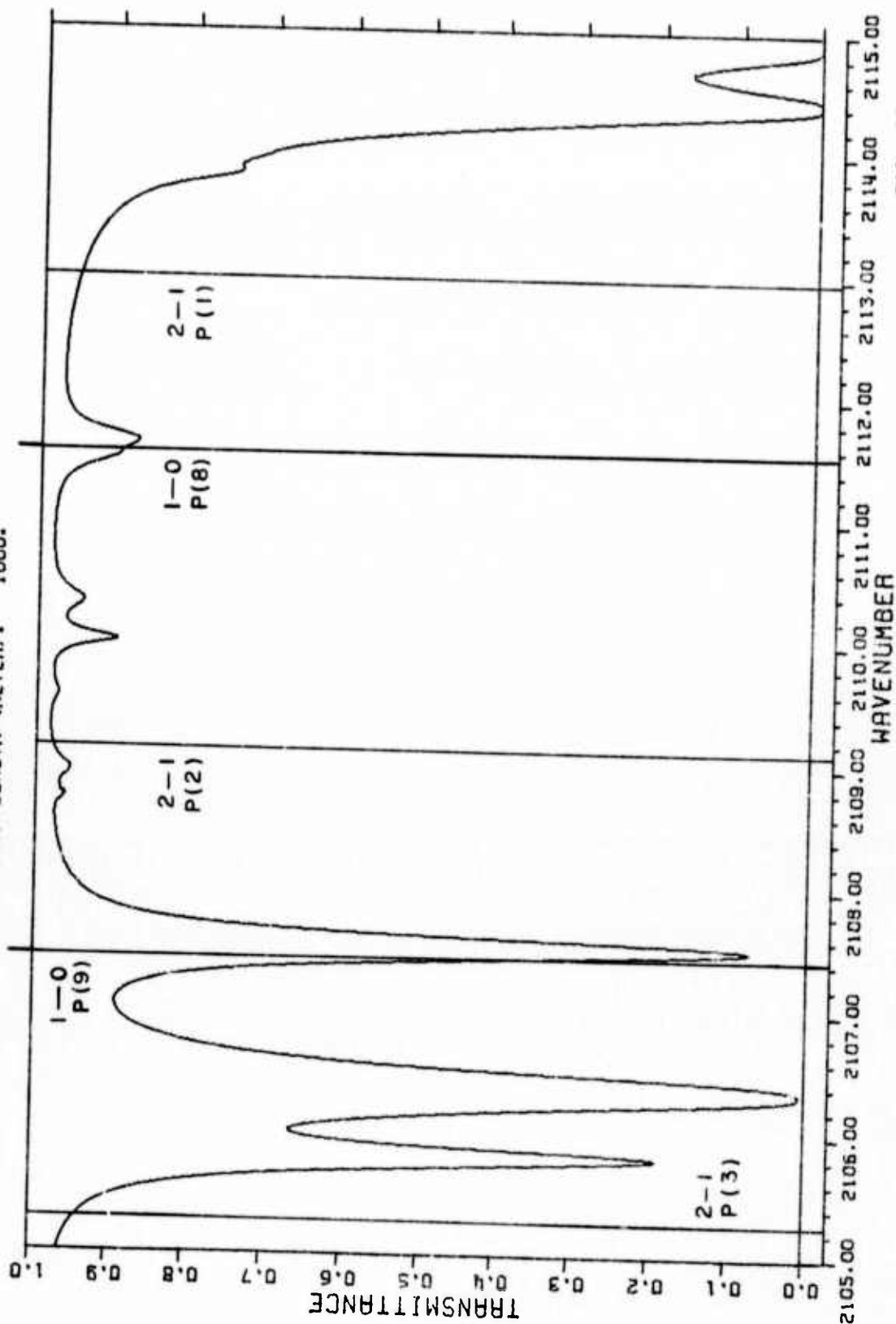


FIG. 16

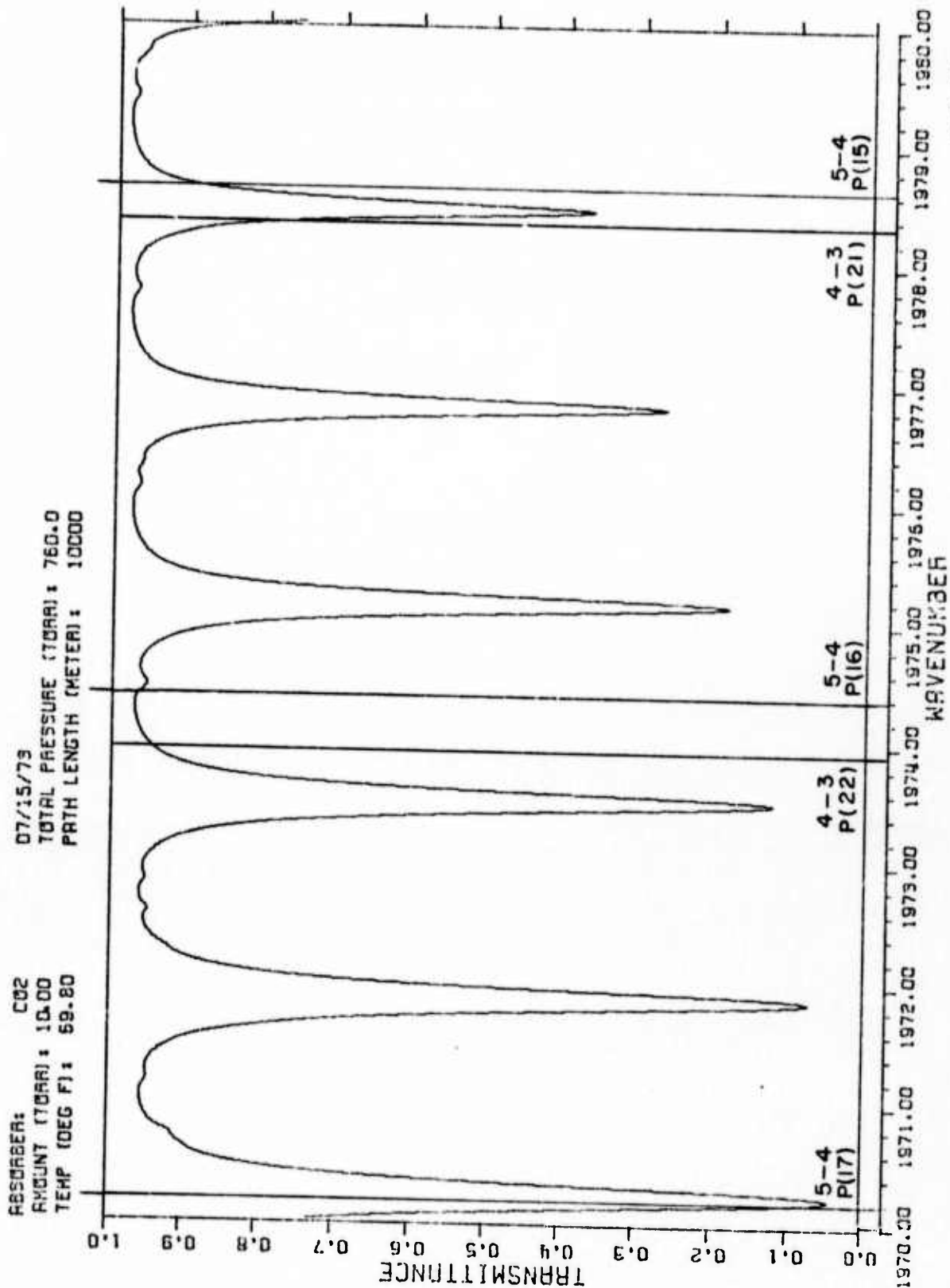


FIG. 17

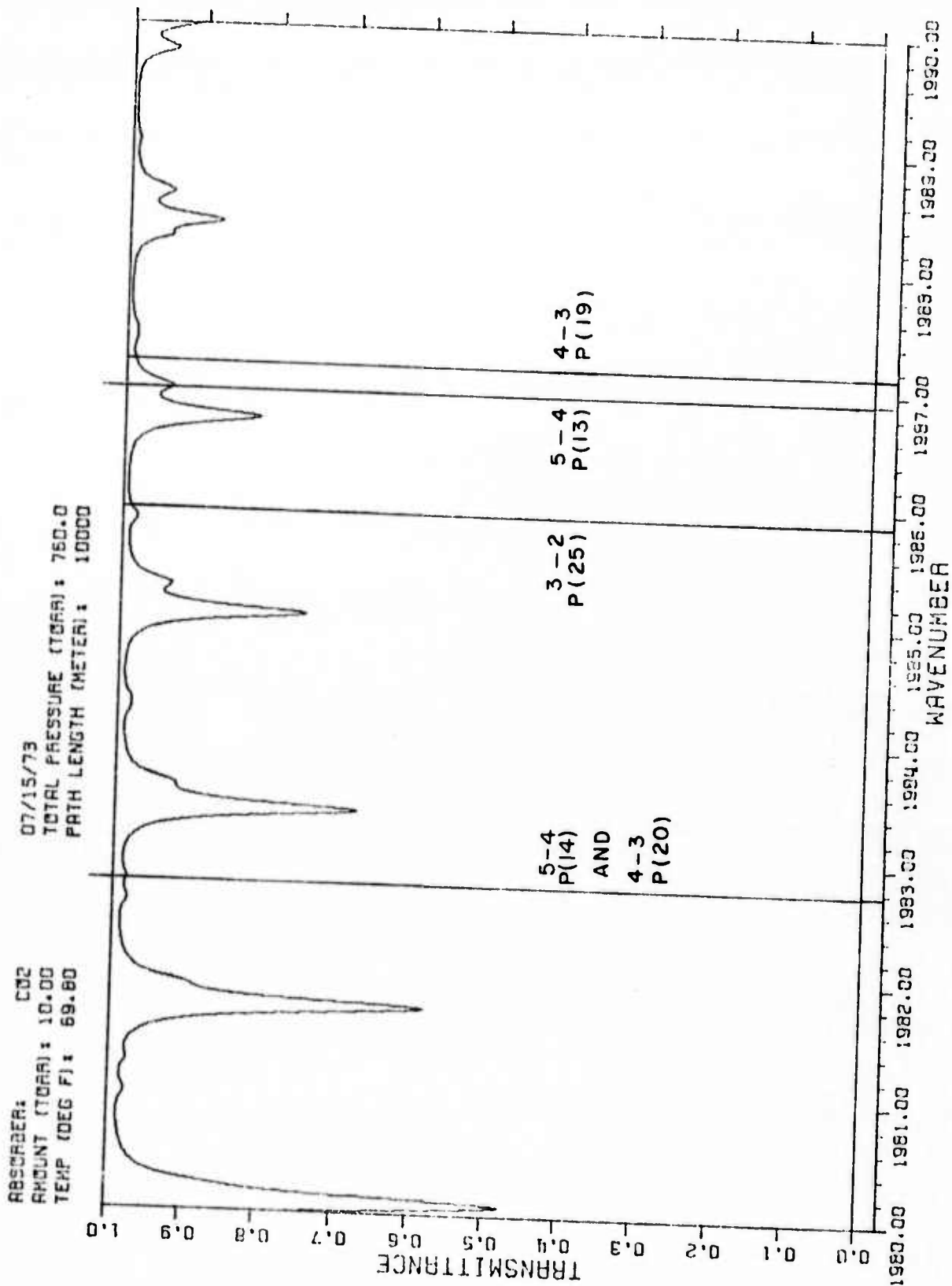


FIG. 18

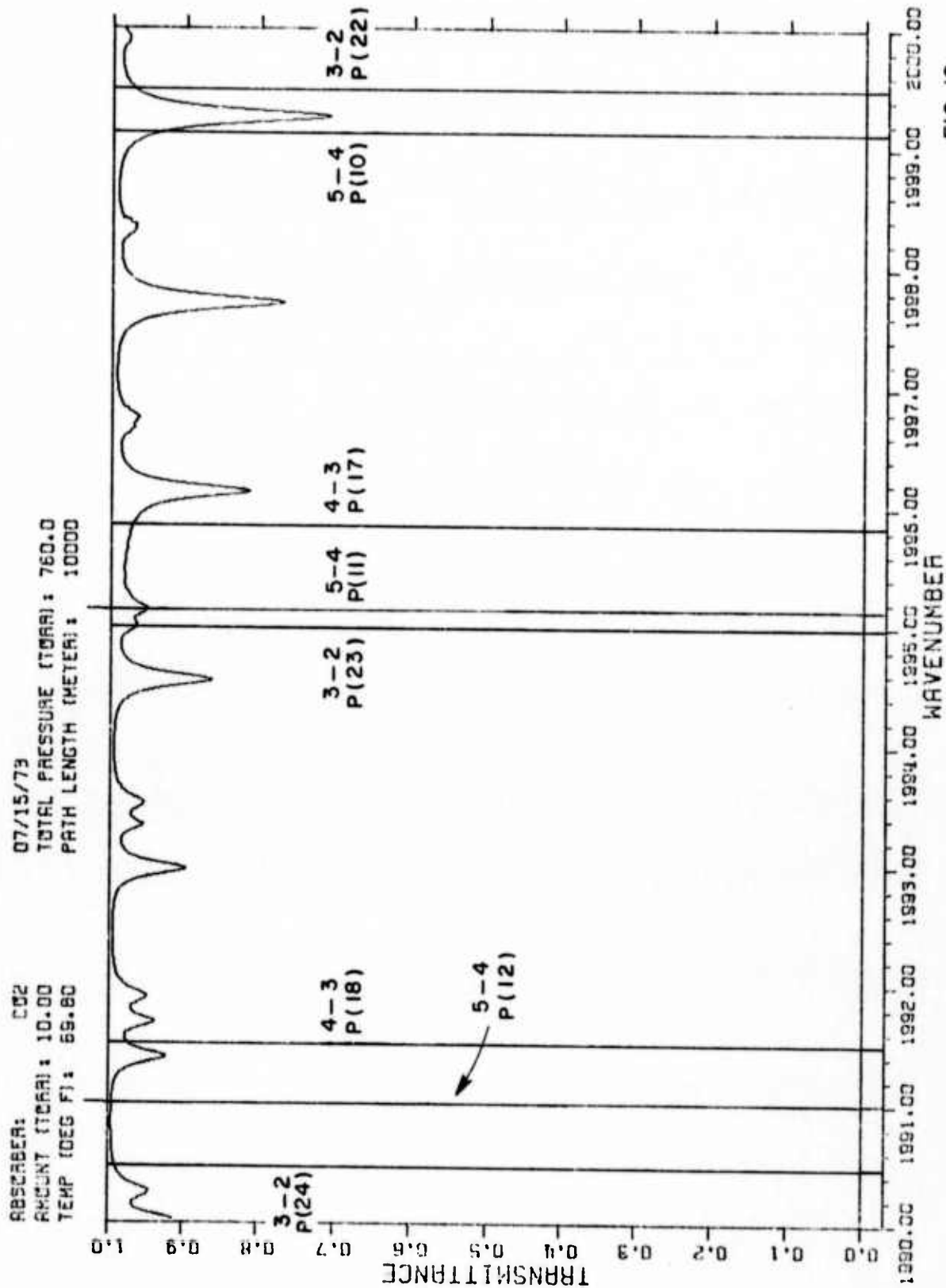


FIG. 19

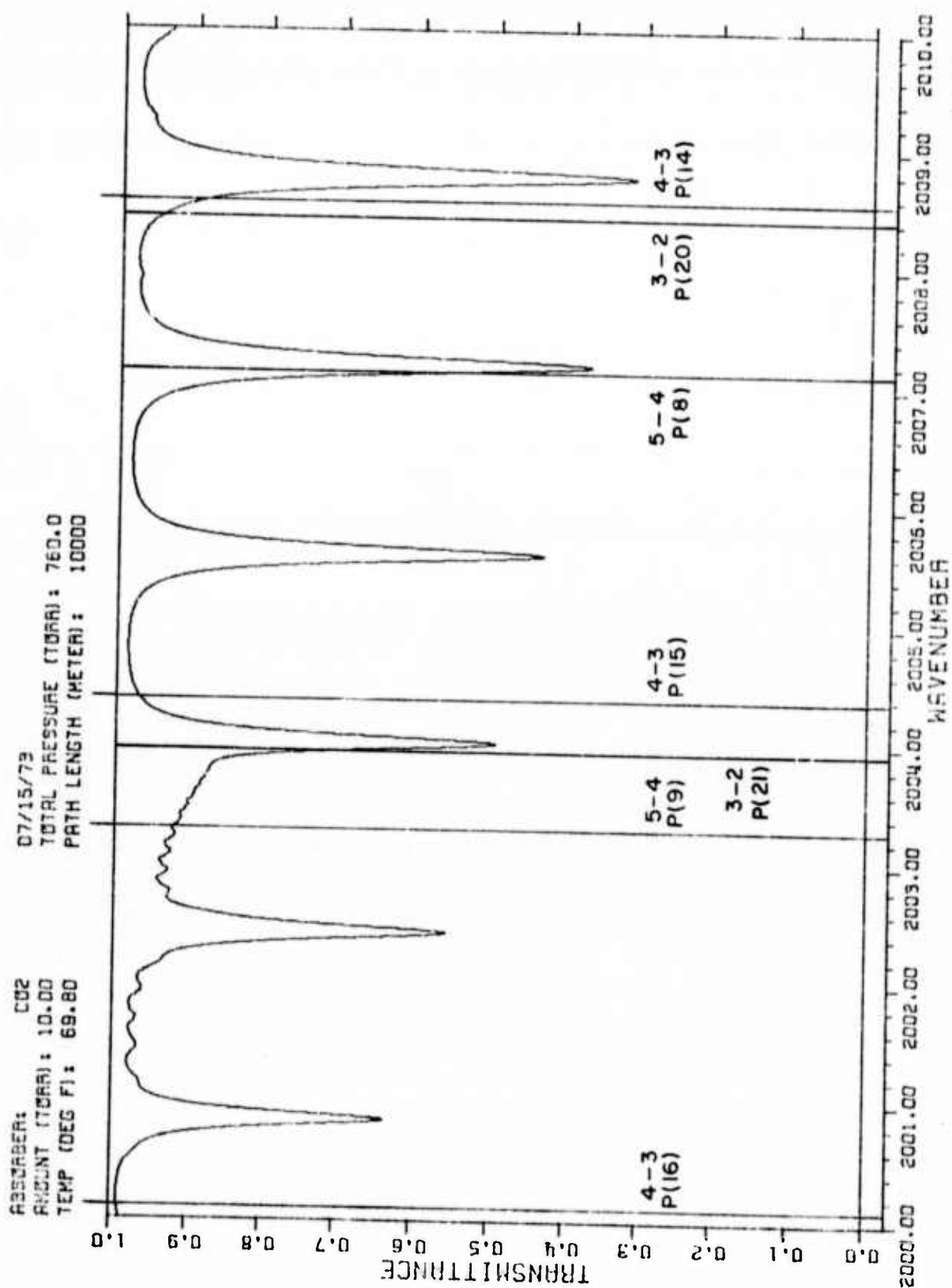


FIG. 20

ABSORBER: 102  
 AMOUNT (TGA): 10.00  
 TEMP (DEG F): 69.80

07/15/73  
 TOTAL PRESSURE (TORR): 760.0  
 PATH LENGTH (METER): 10000

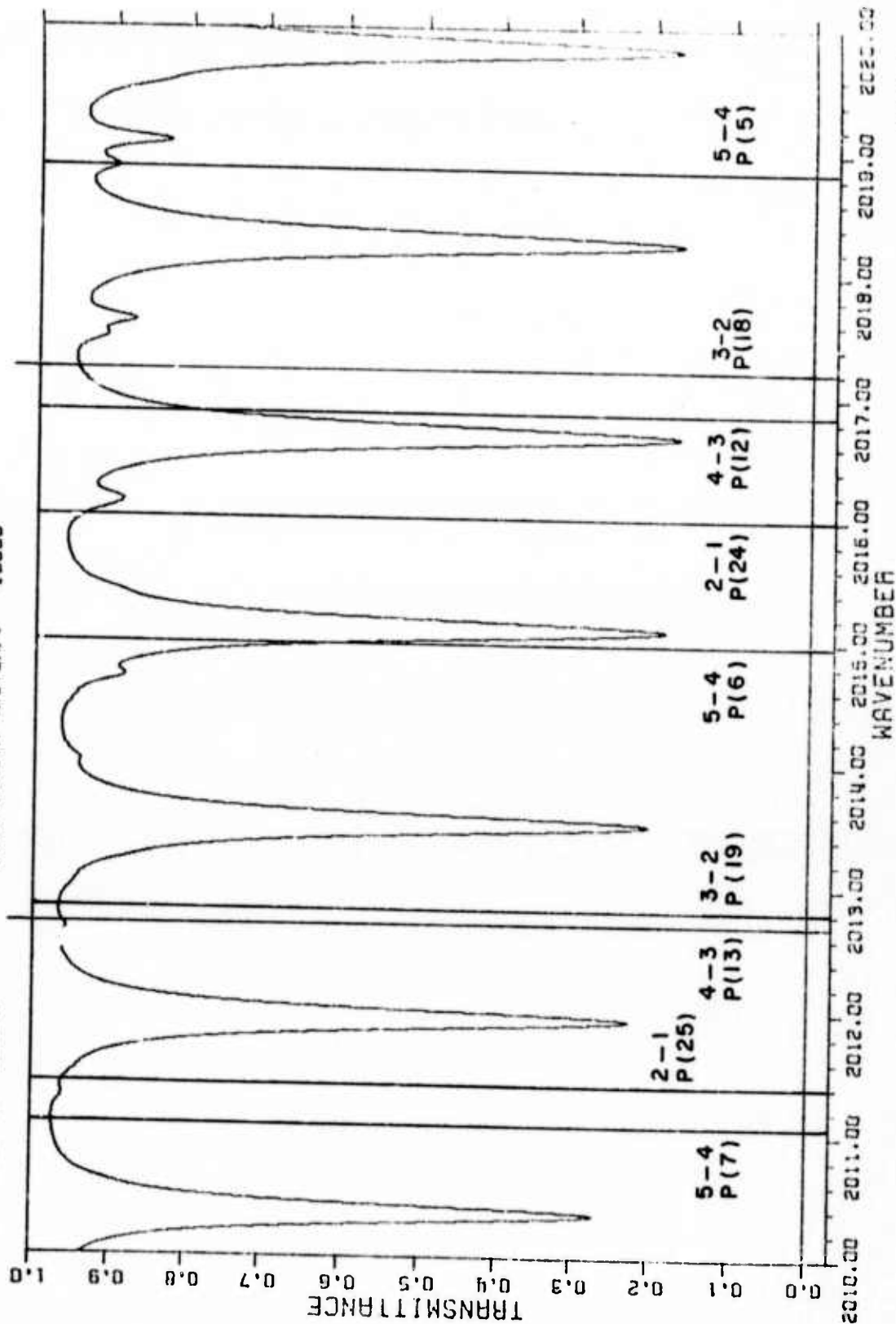


FIG. 2

ABSORBER: CO2  
 AMOUNT (TORR): 10.00  
 TEMP (DEG F): 69.80  
 07/15/73  
 TOTAL PRESSURE (TORR): 760.0  
 PATH LENGTH (METER): 10000

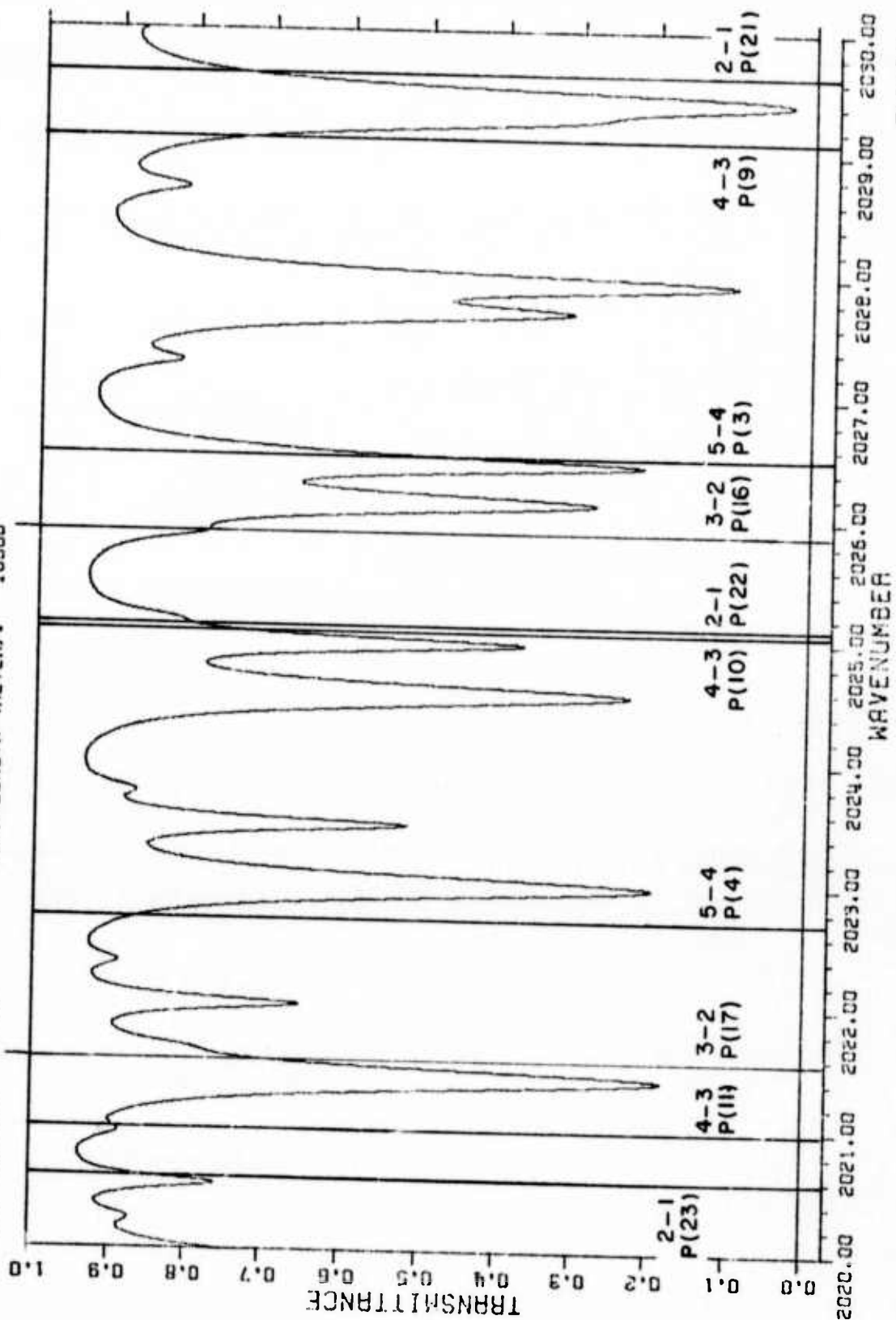


FIG. 22



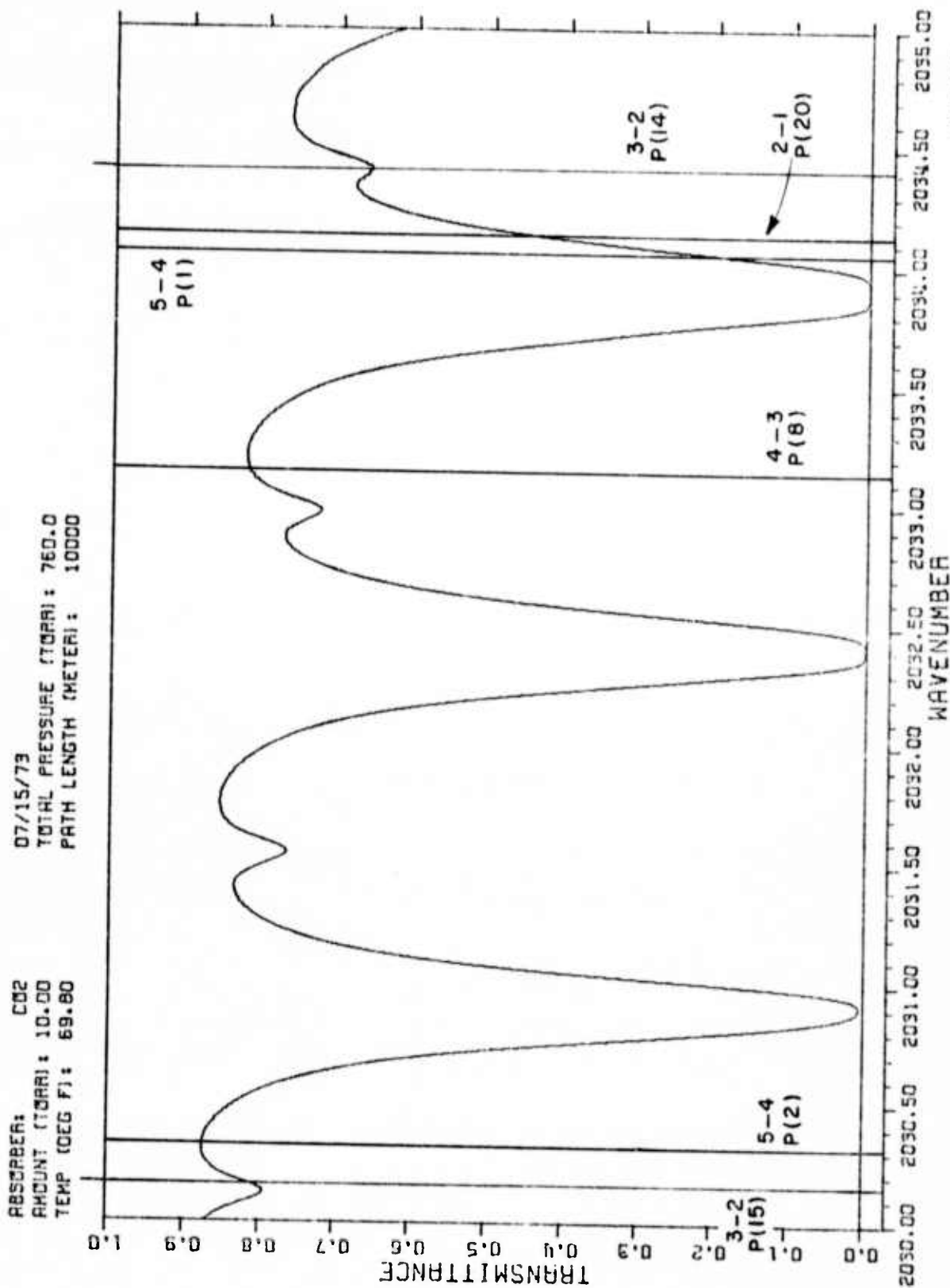


FIG. 23

ABSORBER: CO2  
AMOUNT (TORR): 3.000  
TEMP (DEG F): 69.80

07/10/73  
TOTAL PRESSURE (TORR): 760.0  
PATH LENGTH (METER): 1000.

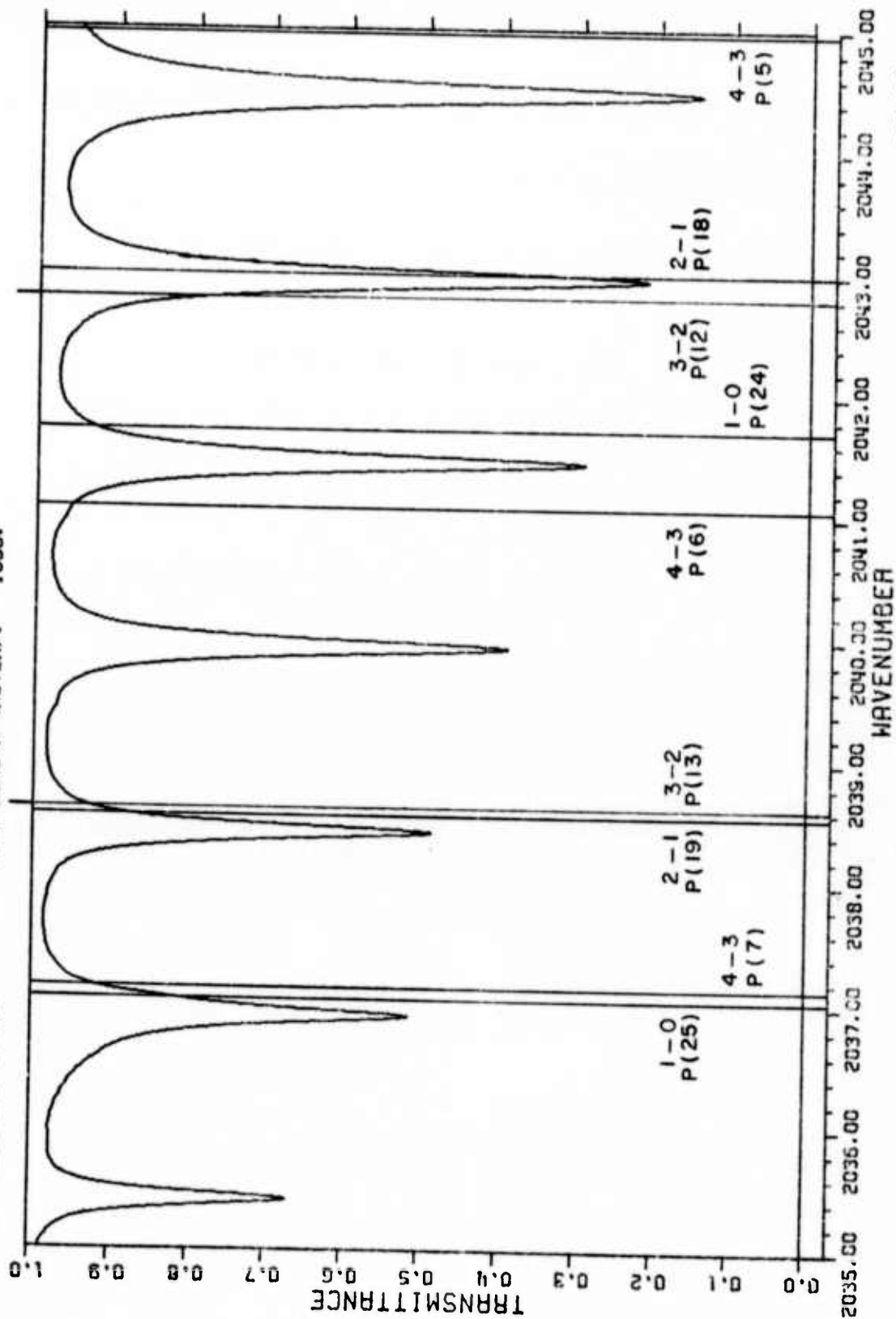


FIG. 24

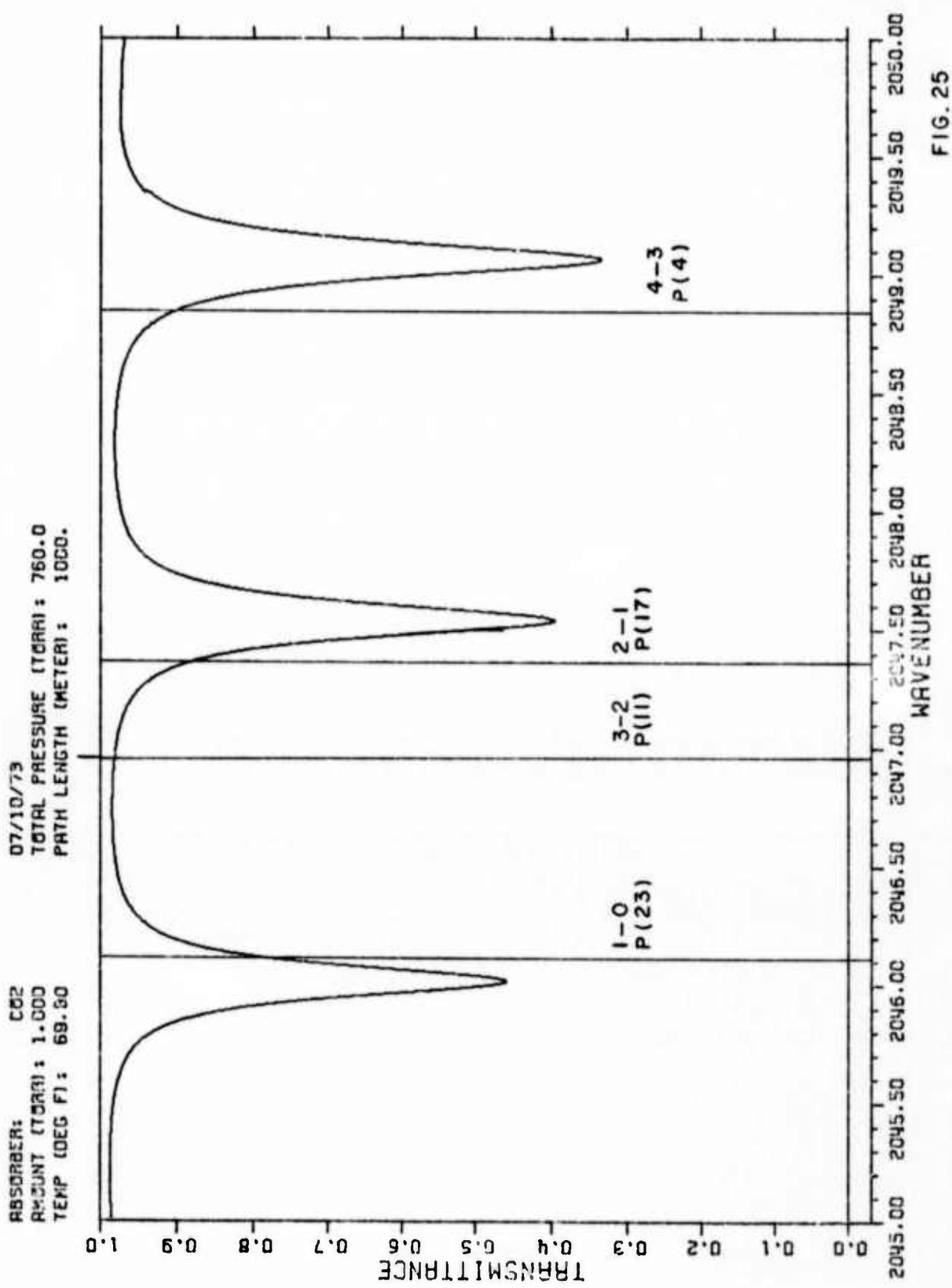


FIG. 25

ABSORBER: C62  
 AMOUNT (TORR): 1.000  
 TEMP (DEG F): 69.80  
 07/10/73  
 TOTAL PRESSURE (TORR): 760.0  
 PATH LENGTH (METER): 1000.

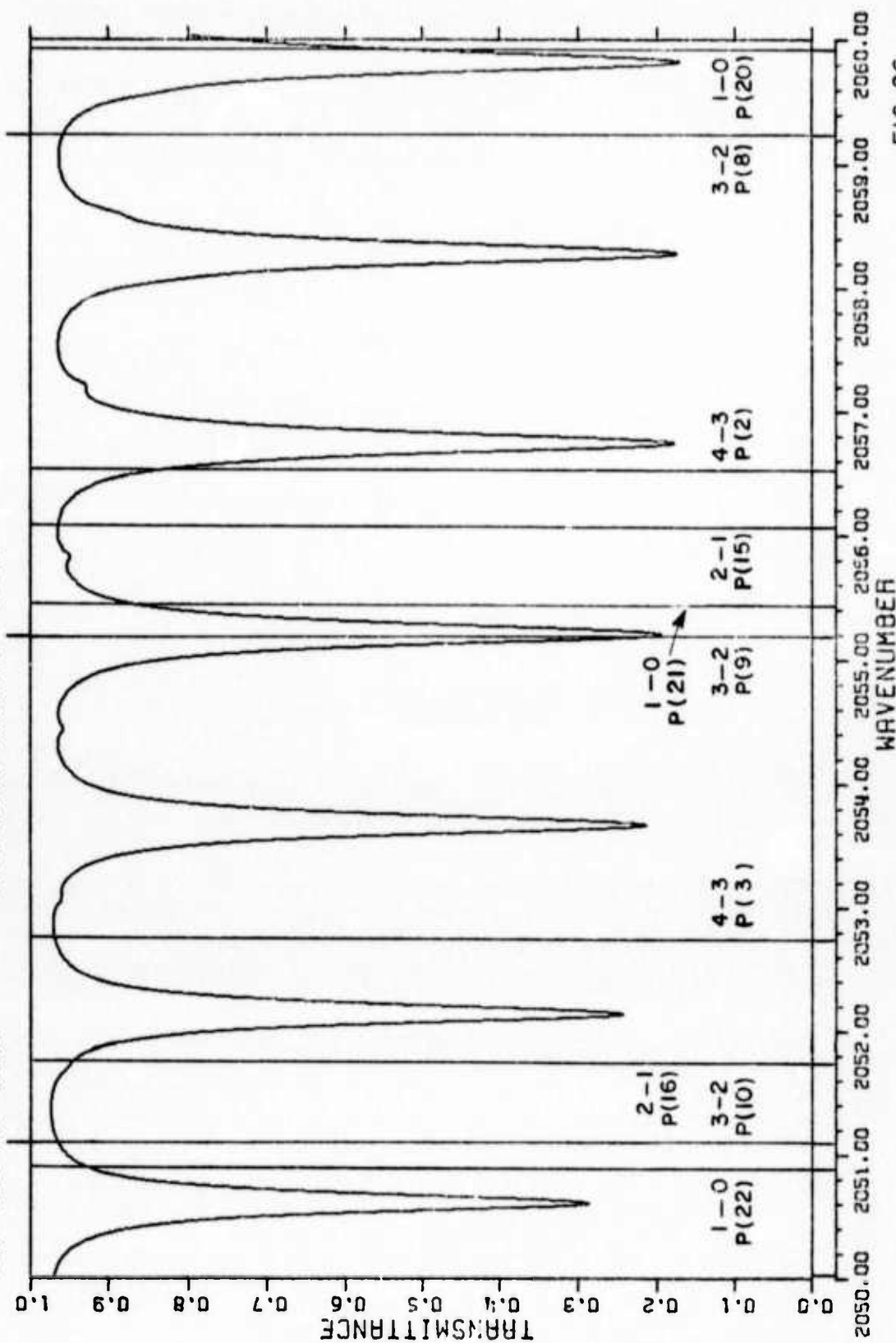


FIG. 26

ABSORBER: CO<sub>2</sub>  
AMOUNT (TORR): 3.000  
TEMP (DEG F): 69.80

07/10/73  
TOTAL PRESSURE (TORR): 760.0  
PATH LENGTH (METER): 1000.

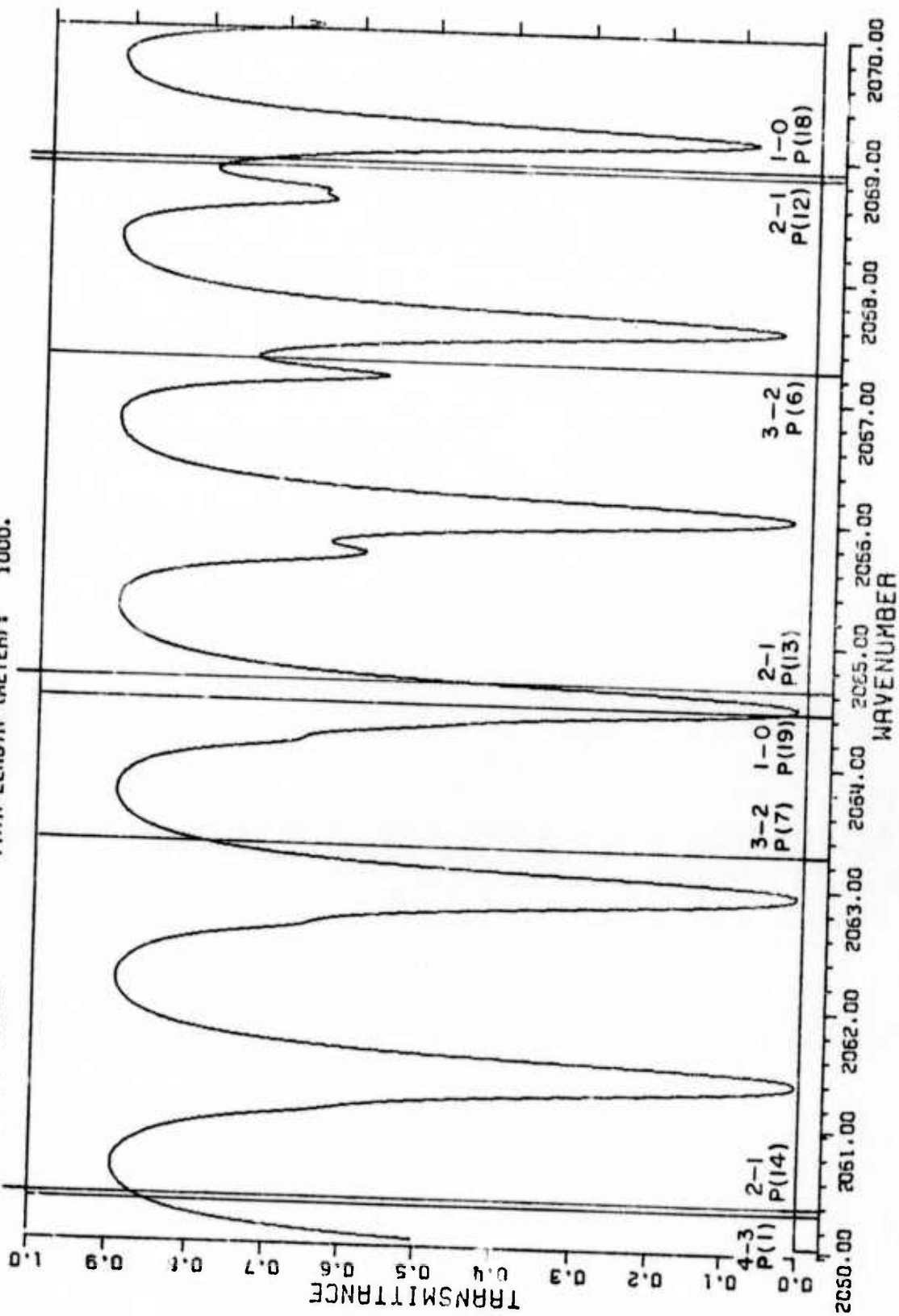


FIG. 27

ABSORBER: CO2  
AMOUNT (TORR): 1.000  
TEMP (DEG F): 69.80

07/15/79  
TOTAL PRESSURE (TORR): 760.0  
PATH LENGTH (METER): 1000.

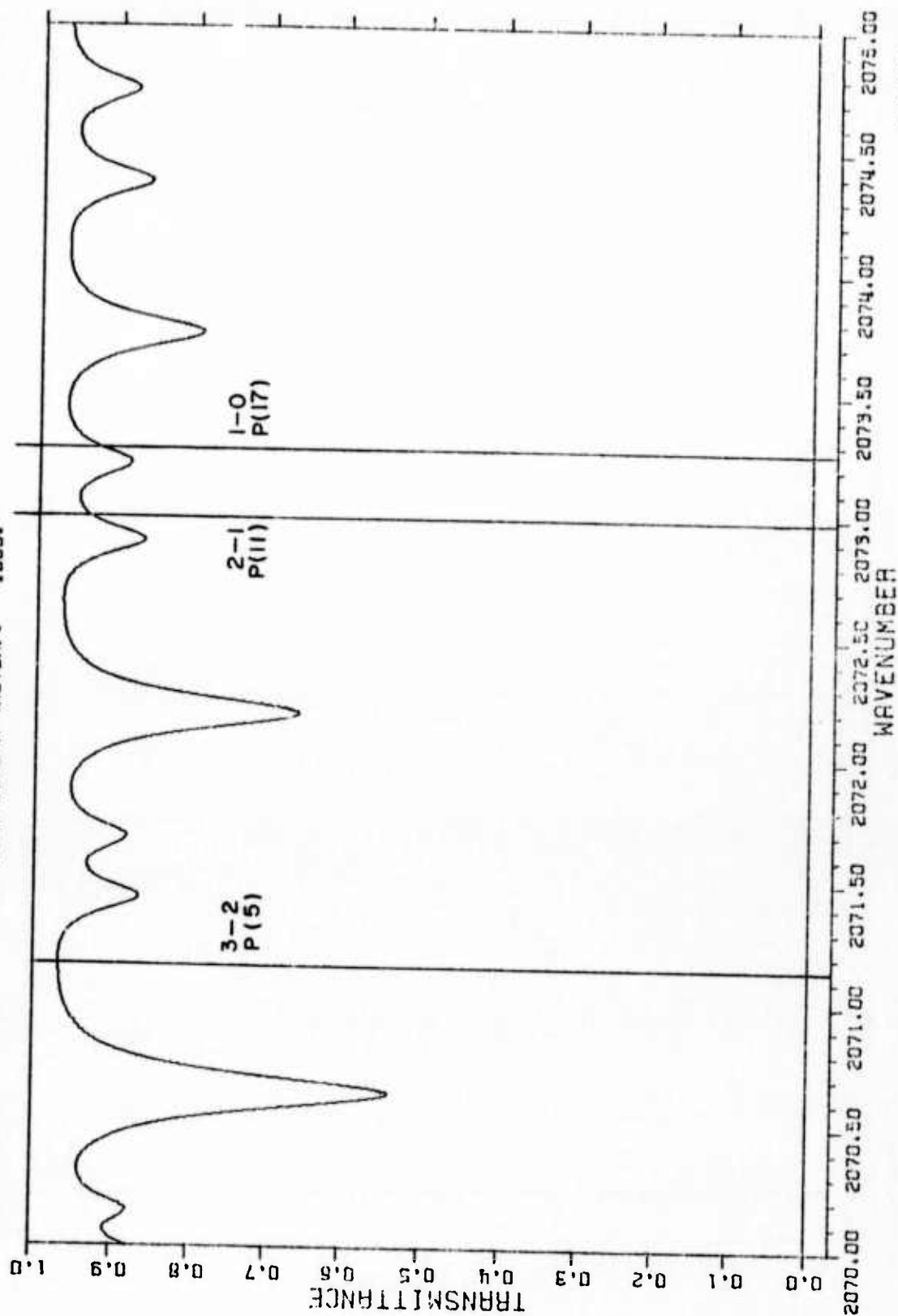


FIG. 28

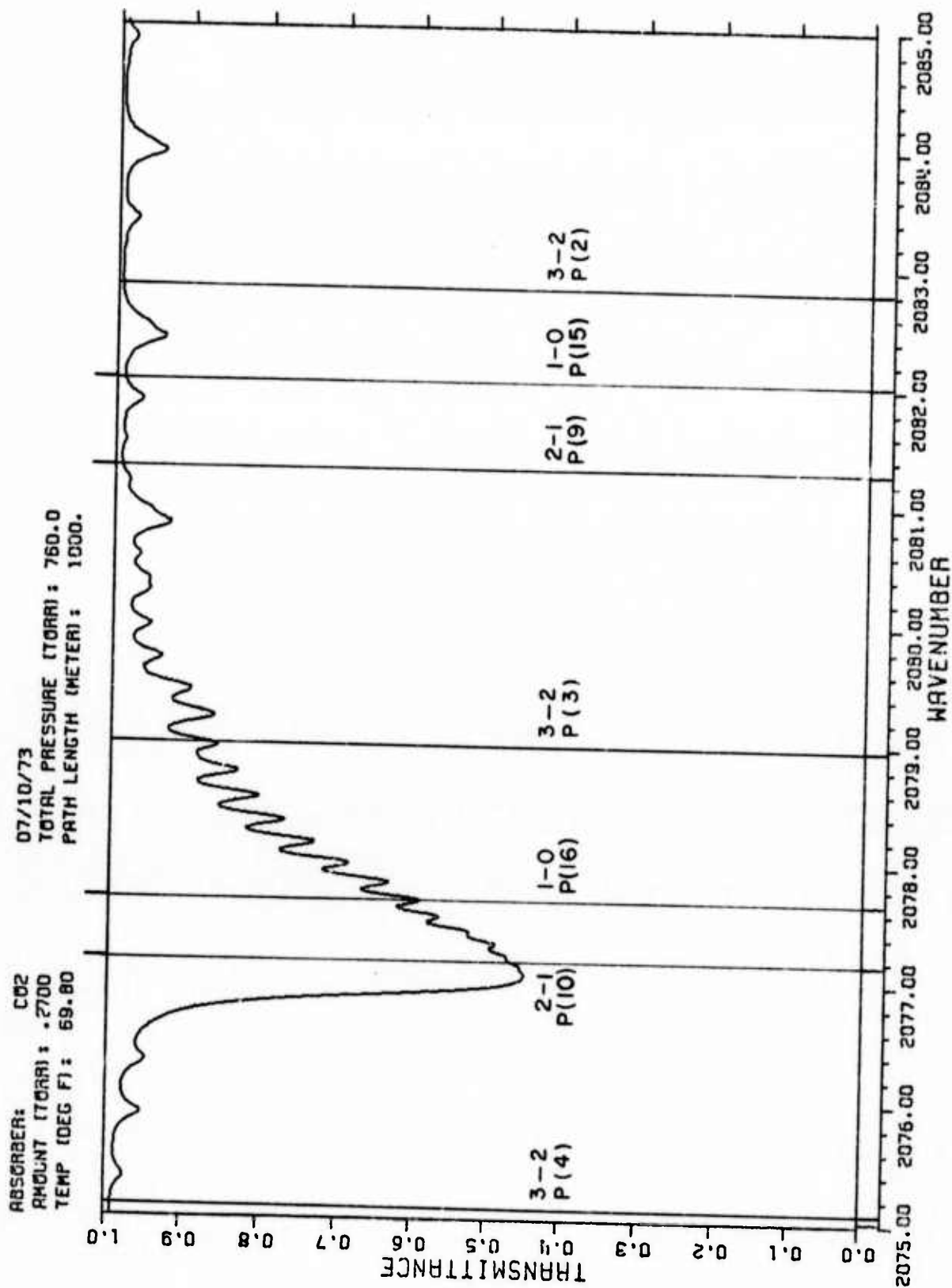


FIG.29



ABSORBER: CO2  
AMOUNT (TORR): 3.000  
TEMP (DEG F): 69.80  
07/10/73  
TOTAL PRESSURE (TORR): 760.0  
PATH LENGTH (METER): 1000.

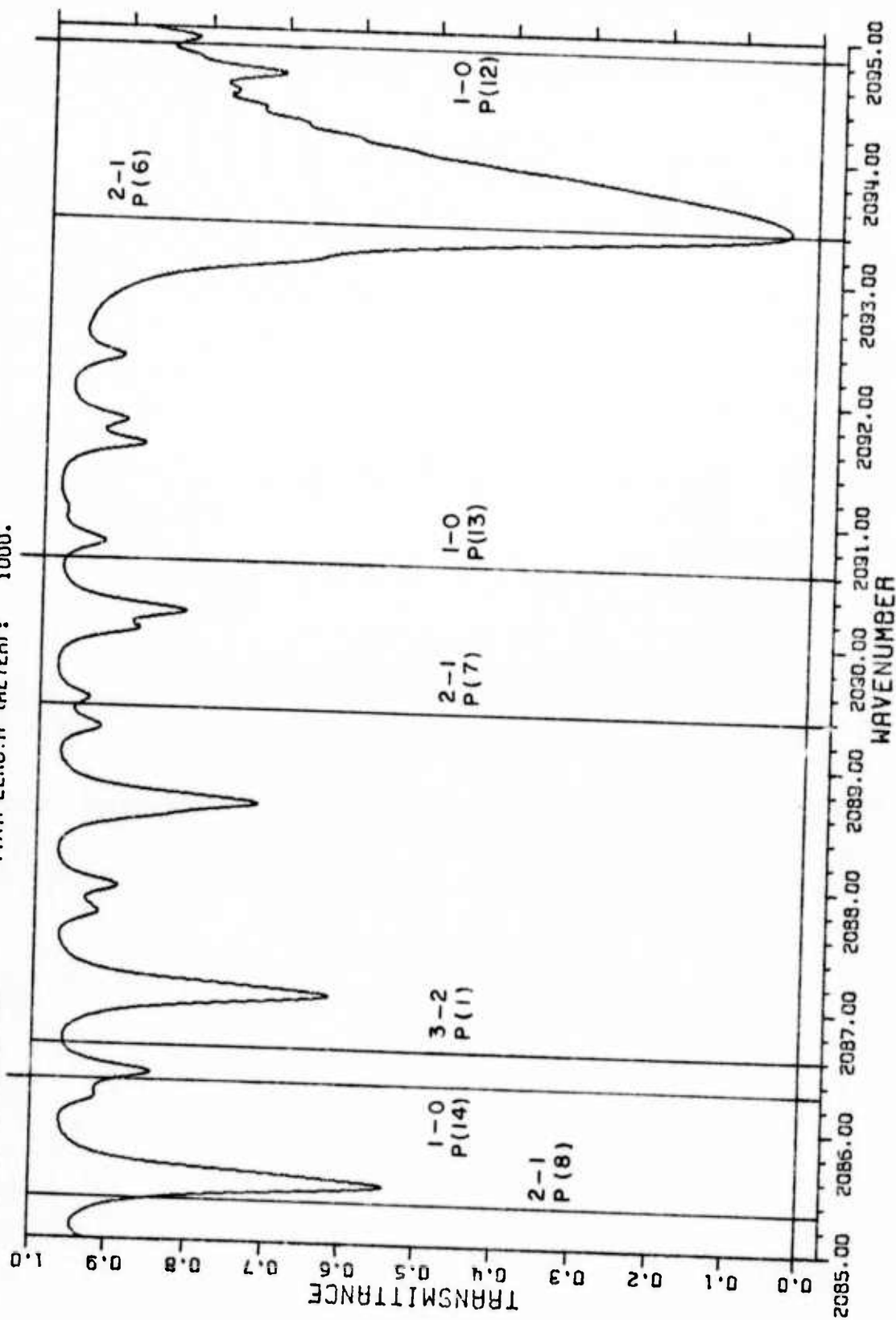


FIG. 30

ABSORBER: C02  
 AMOUNT (TORR): 10.00  
 TEMP (DEG F): 59.80  
 07/10/73  
 TOTAL PRESSURE (TORR): 760.0  
 PATH LENGTH (METER): 1000.

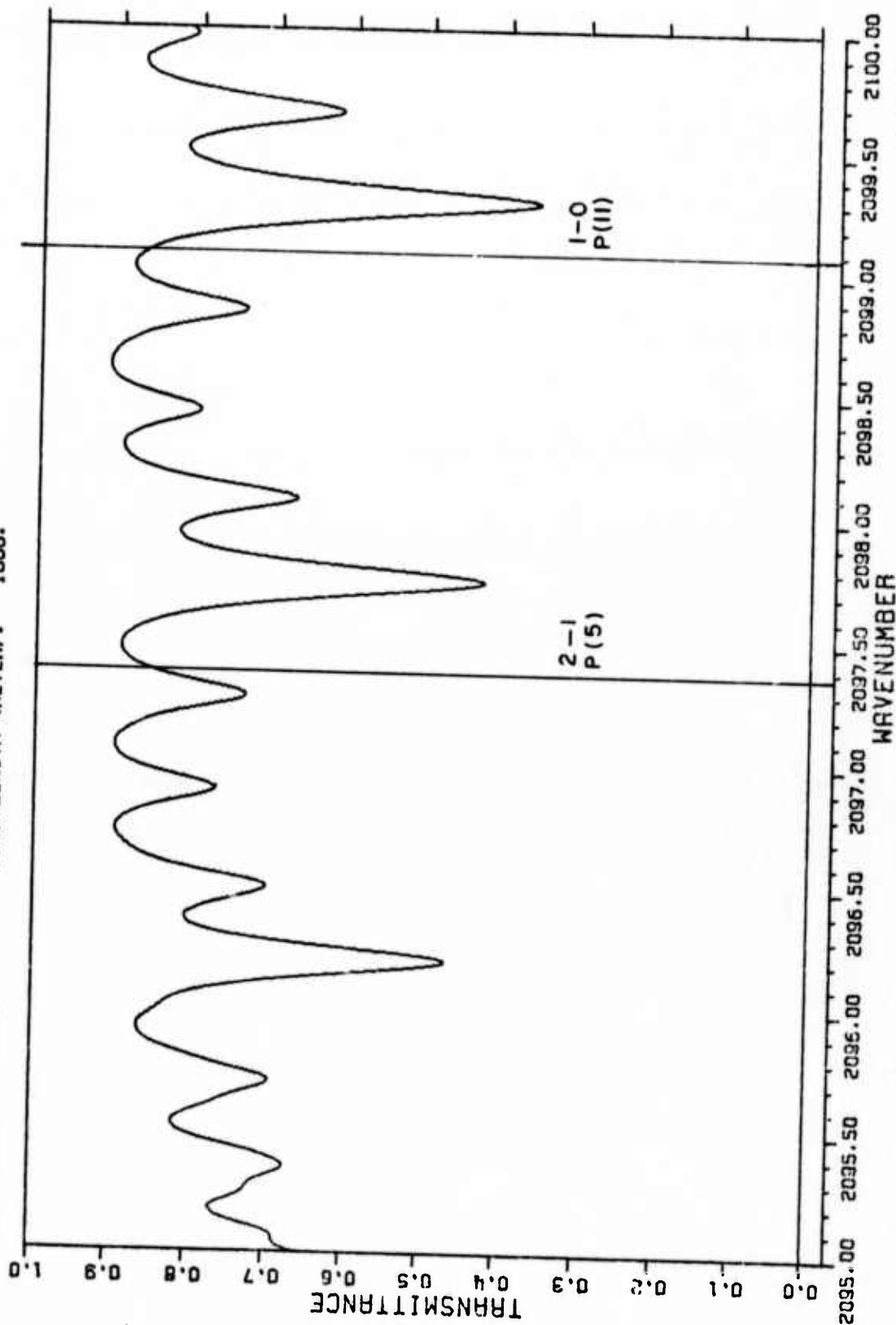


FIG. 31

RECORDED: C02  
ANALYST (TGA): 10.00  
TEMP (DEC 7): 69.80

07/11/79  
TOTAL PRESSURE (TGA): 760.0  
PATH LENGTH (METER): 1000.

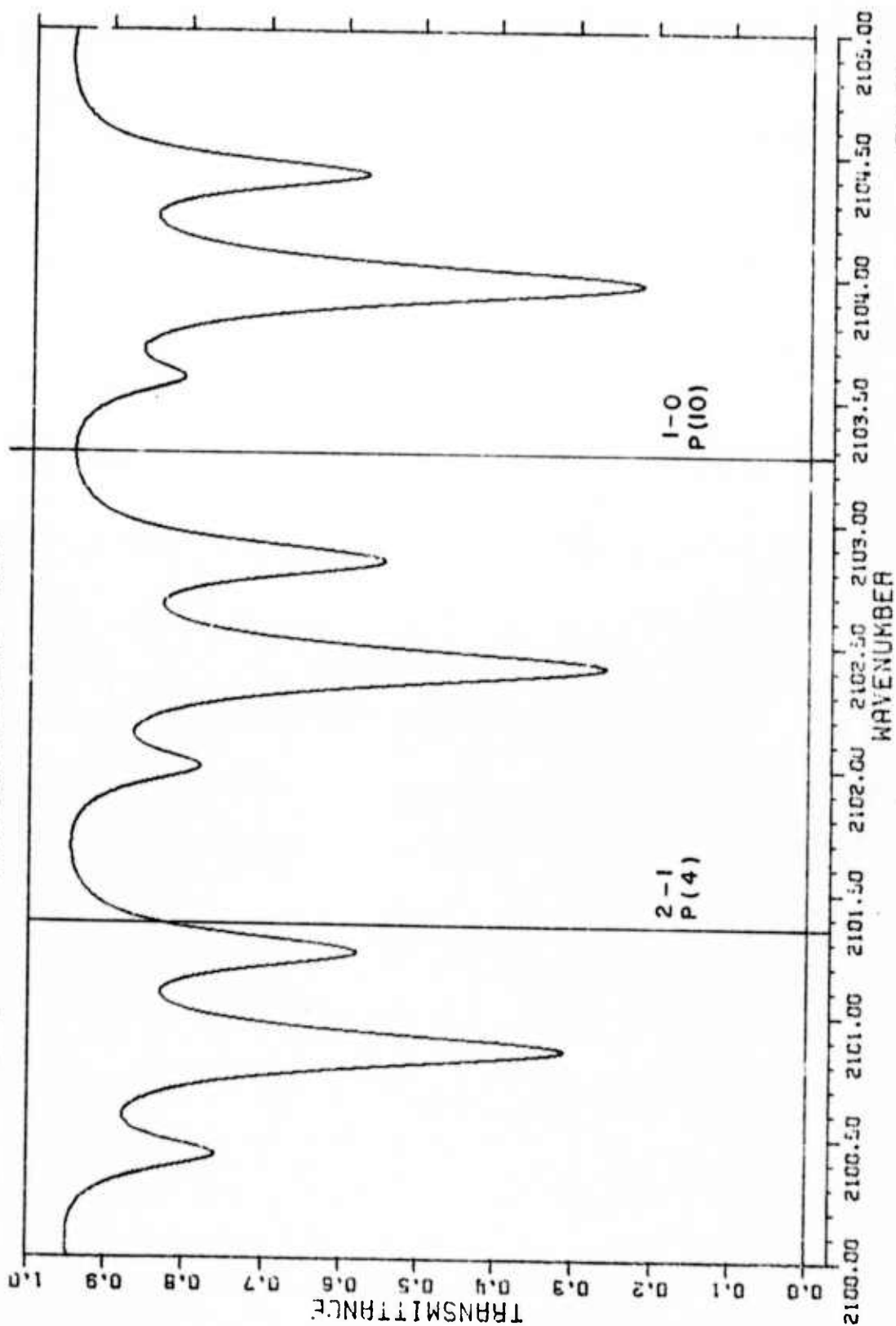


FIG. 32

ABSORBER: CO2  
AMOUNT (TORR): 10.00  
TEMP (DEG F): 69.80  
07/10/73  
TOTAL PRESSURE (TORR): 760.0  
PATH LENGTH (METER): 1000.

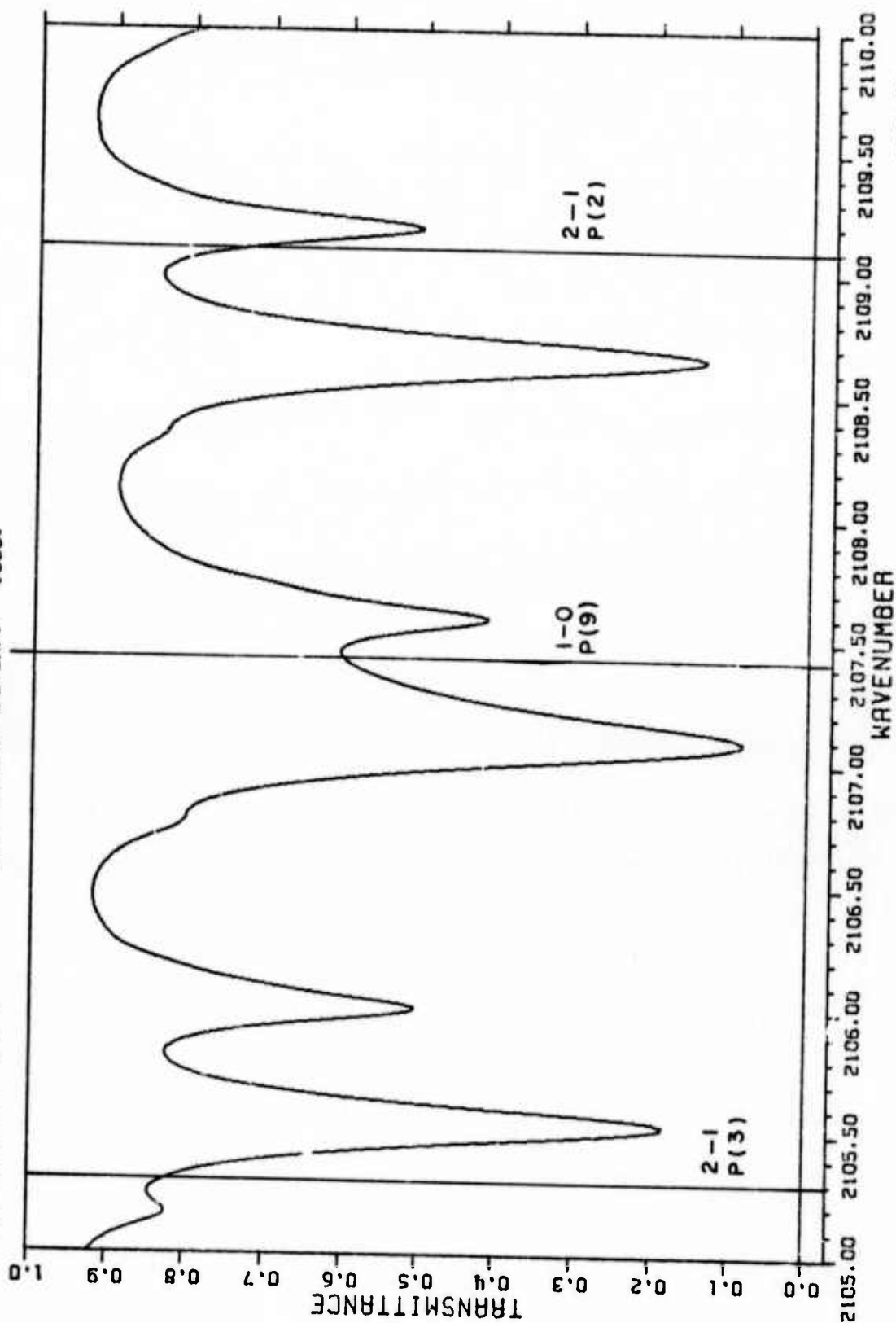


FIG. 33

ABSORBER: CO2  
AMOUNT (TERR): 10.00  
TEMP (DEG F): 69.80

07/10/73  
TOTAL PRESSURE (TERR): 760.0  
PATH LENGTH (METER): 1000.

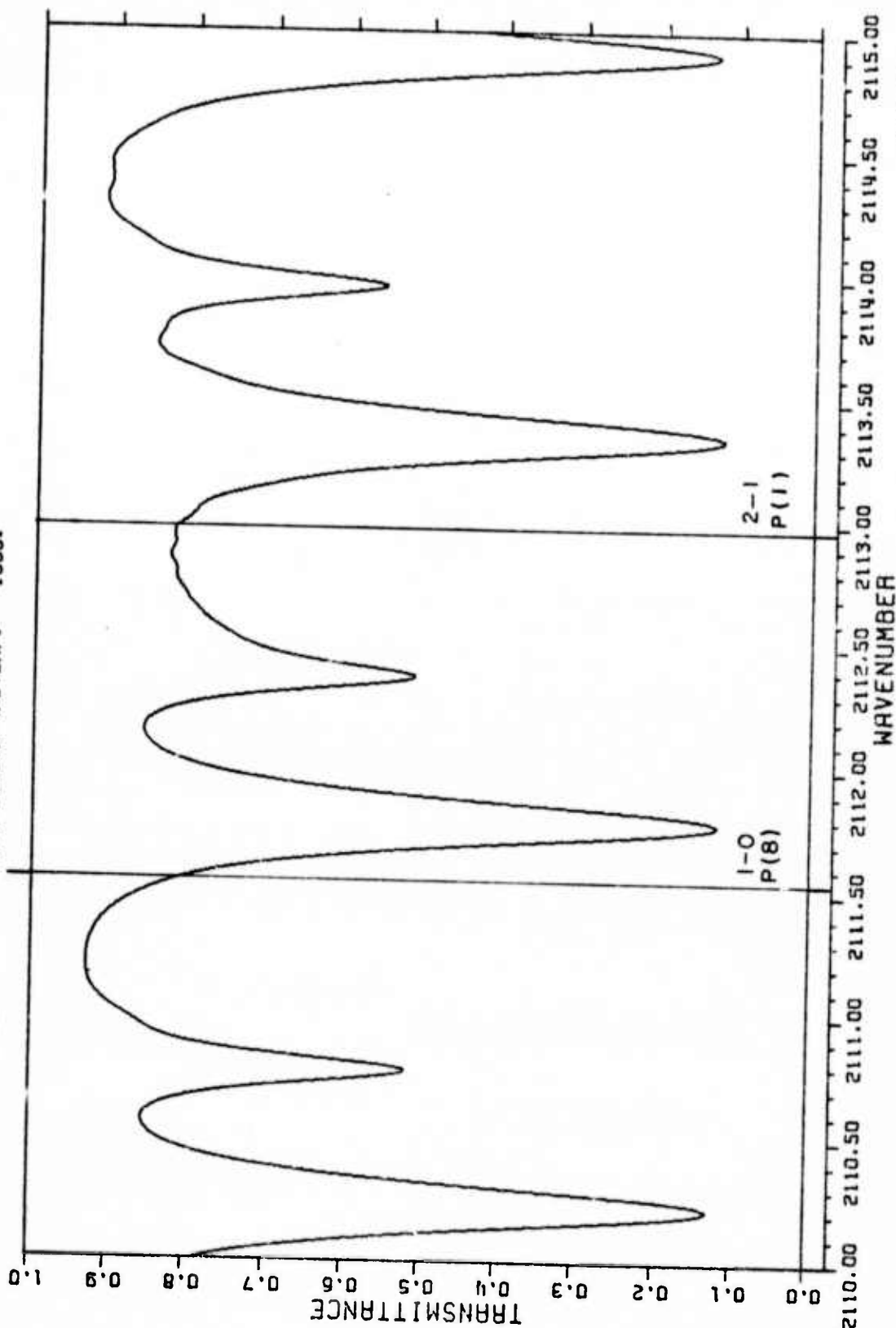


FIG. 34

ABSTRACT: CD  
 AMOUNT (TORR): 1.000  
 TEMP (DEG F): 69.80

07/18/73  
 TOTAL PRESSURE (TORR): 760.0  
 PATH LENGTH (METER): 10000

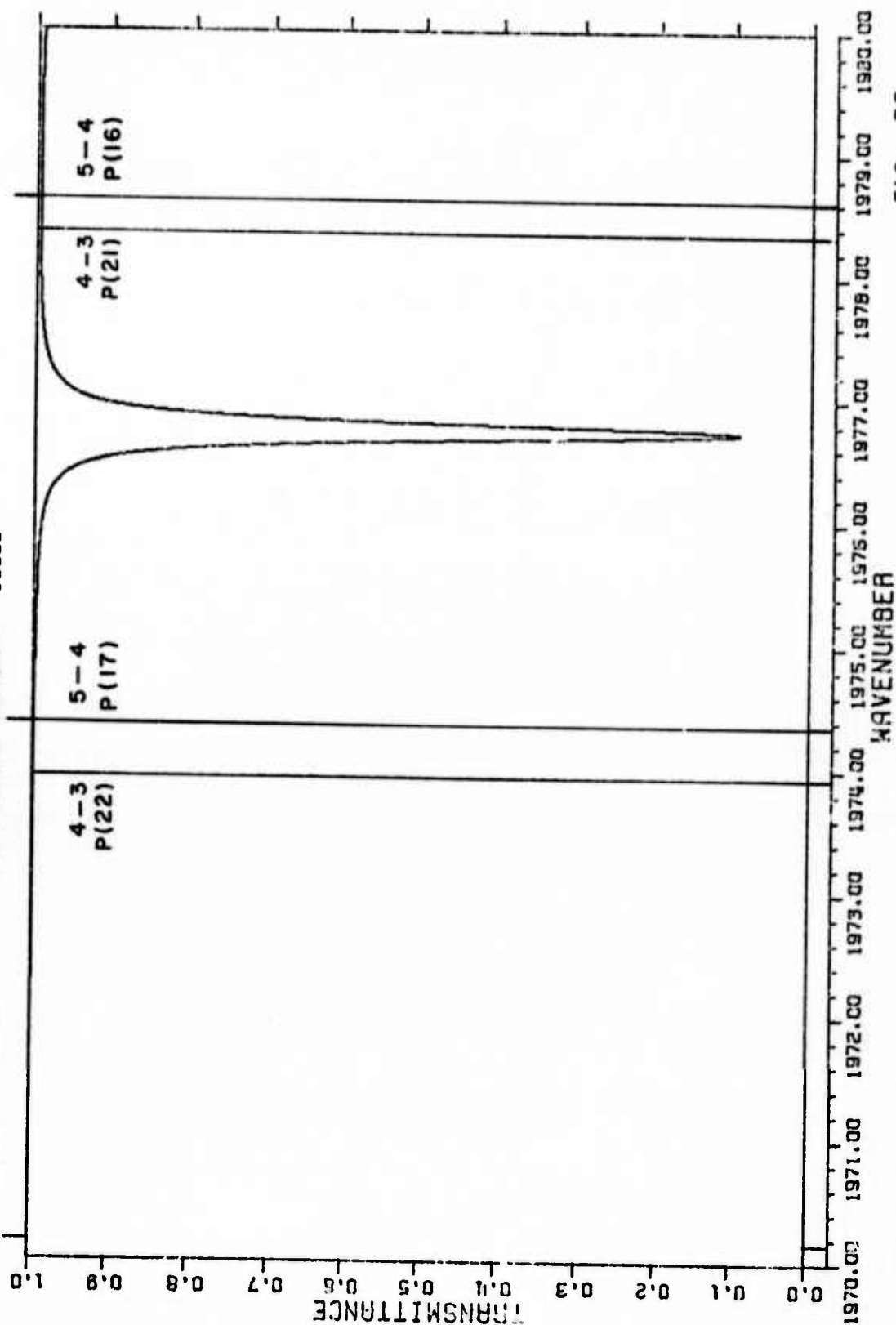


FIG. 35

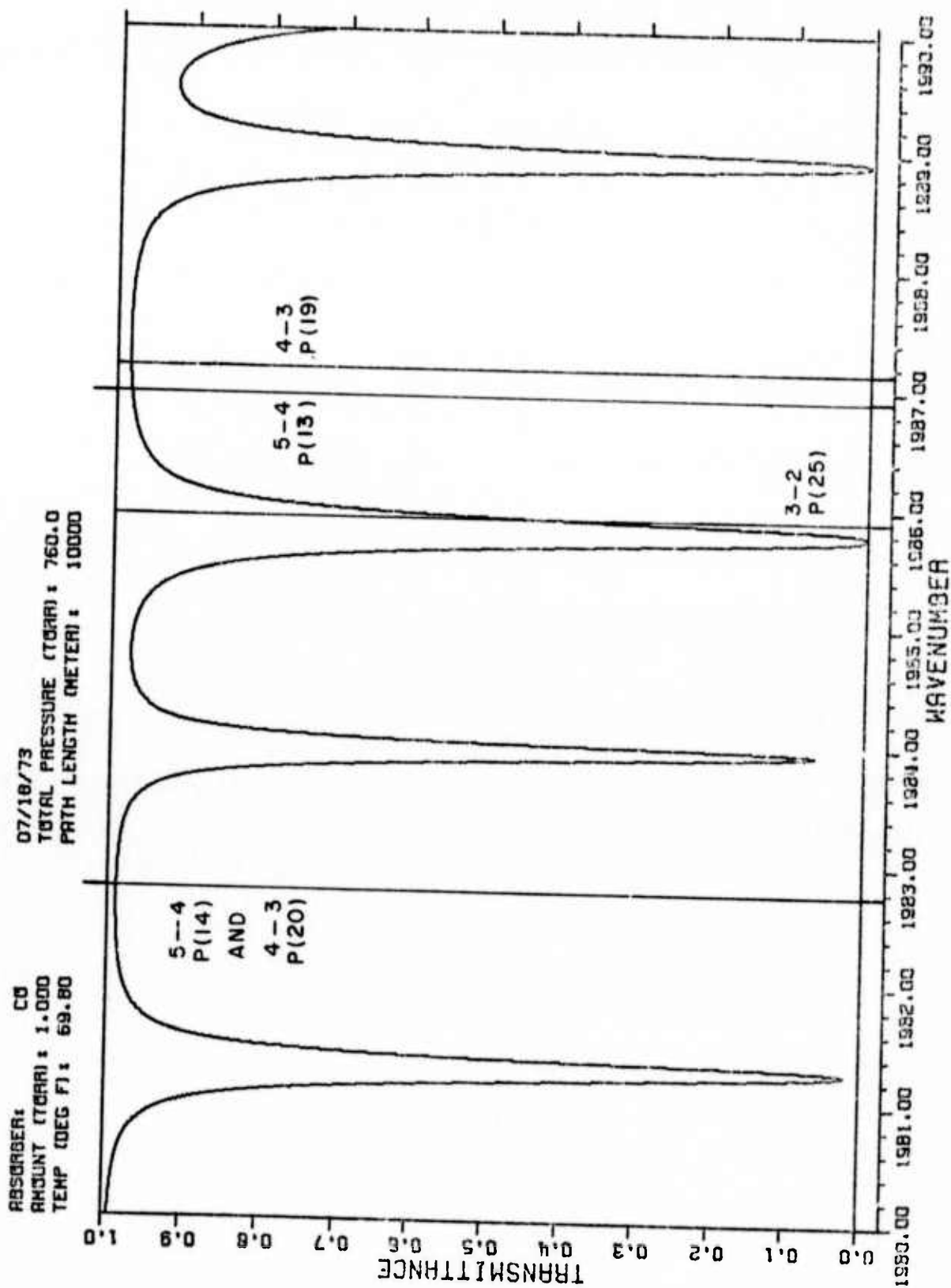


FIG. 36



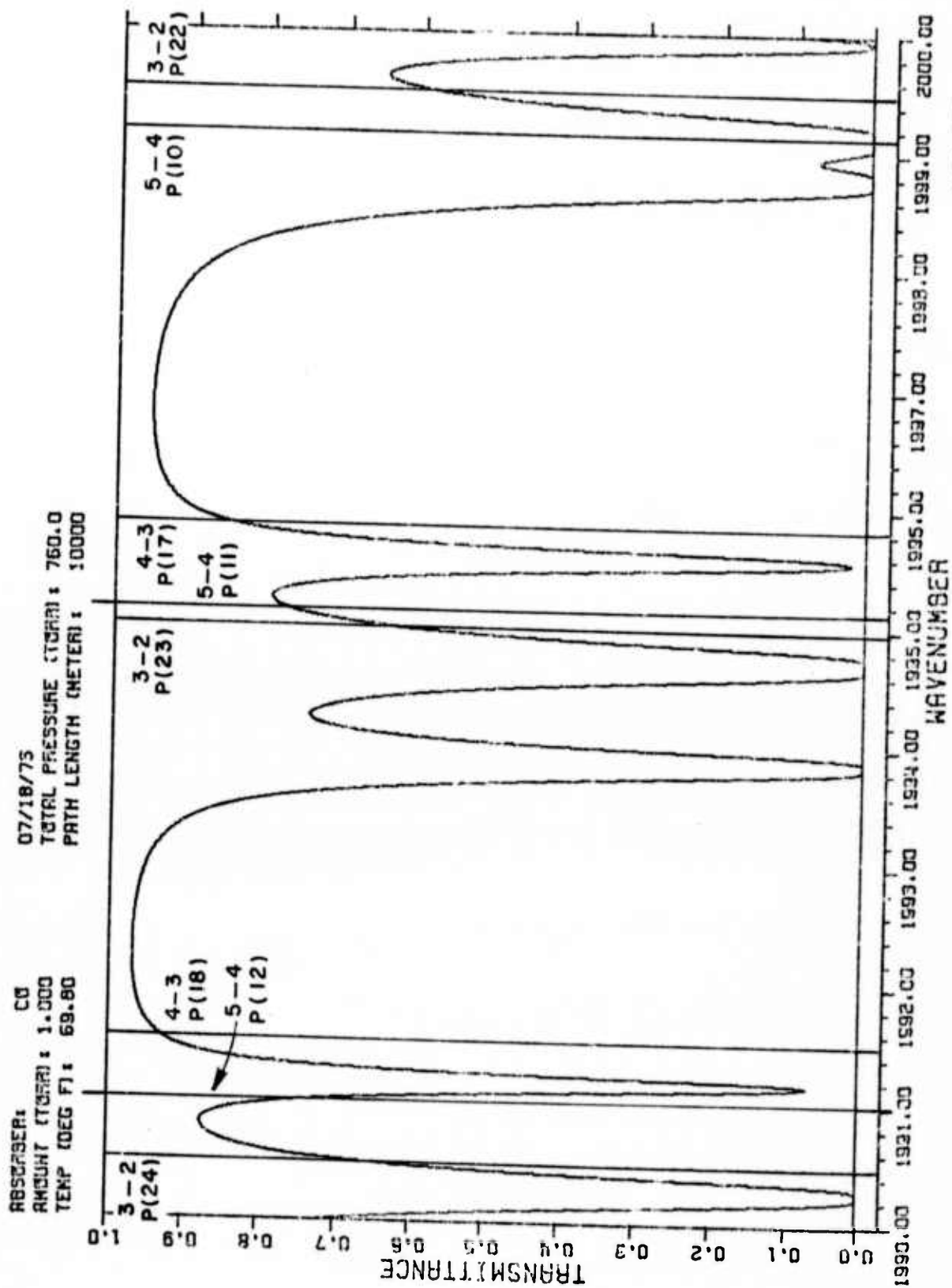


FIG. 37

ABSORBER: CO  
AMOUNT (TERR): .1000  
TEMP (DEG F): 69.80

07/16/73  
TOTAL PRESSURE (TERR): 760.0  
PATH LENGTH (METER): 1000.

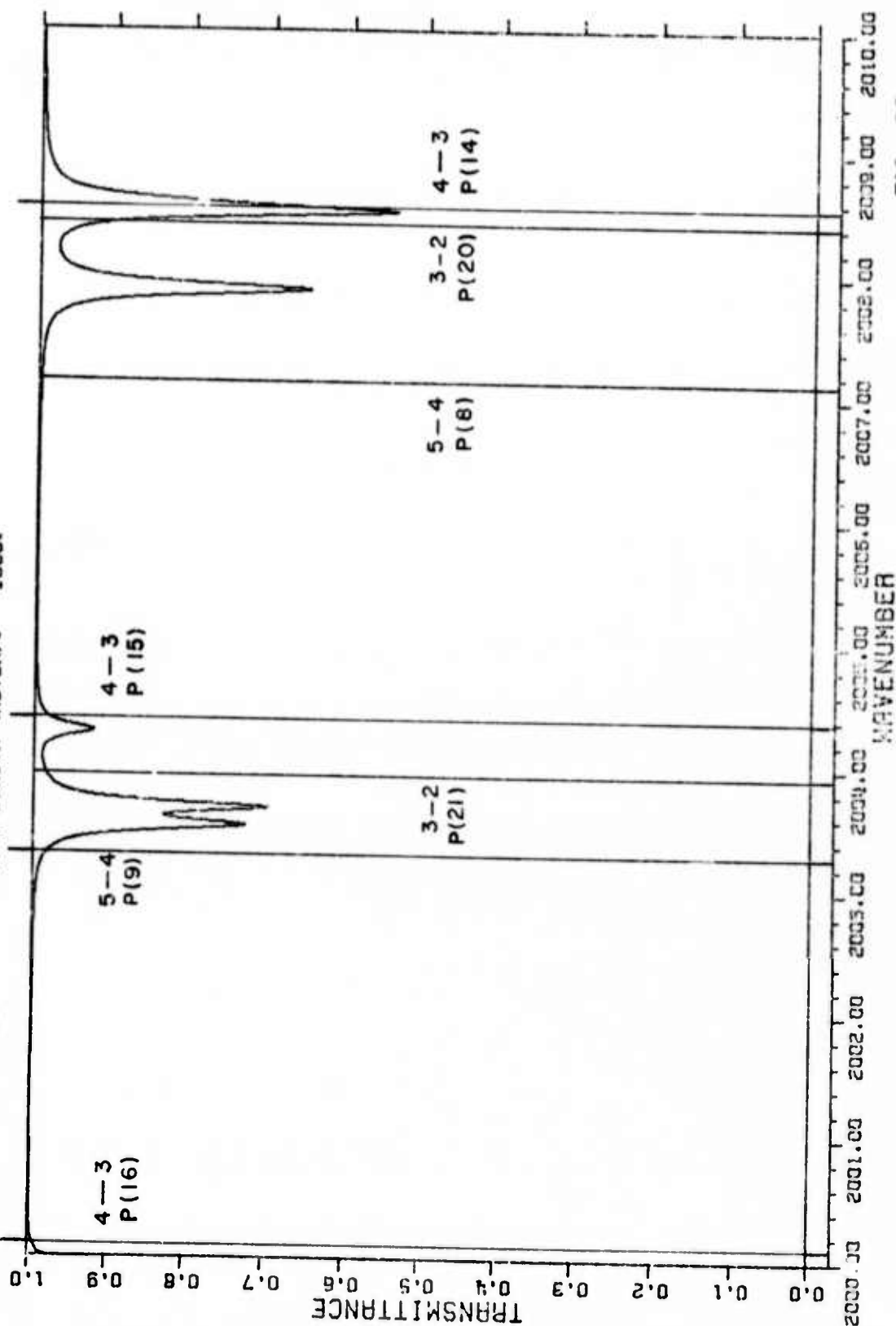


FIG. 38

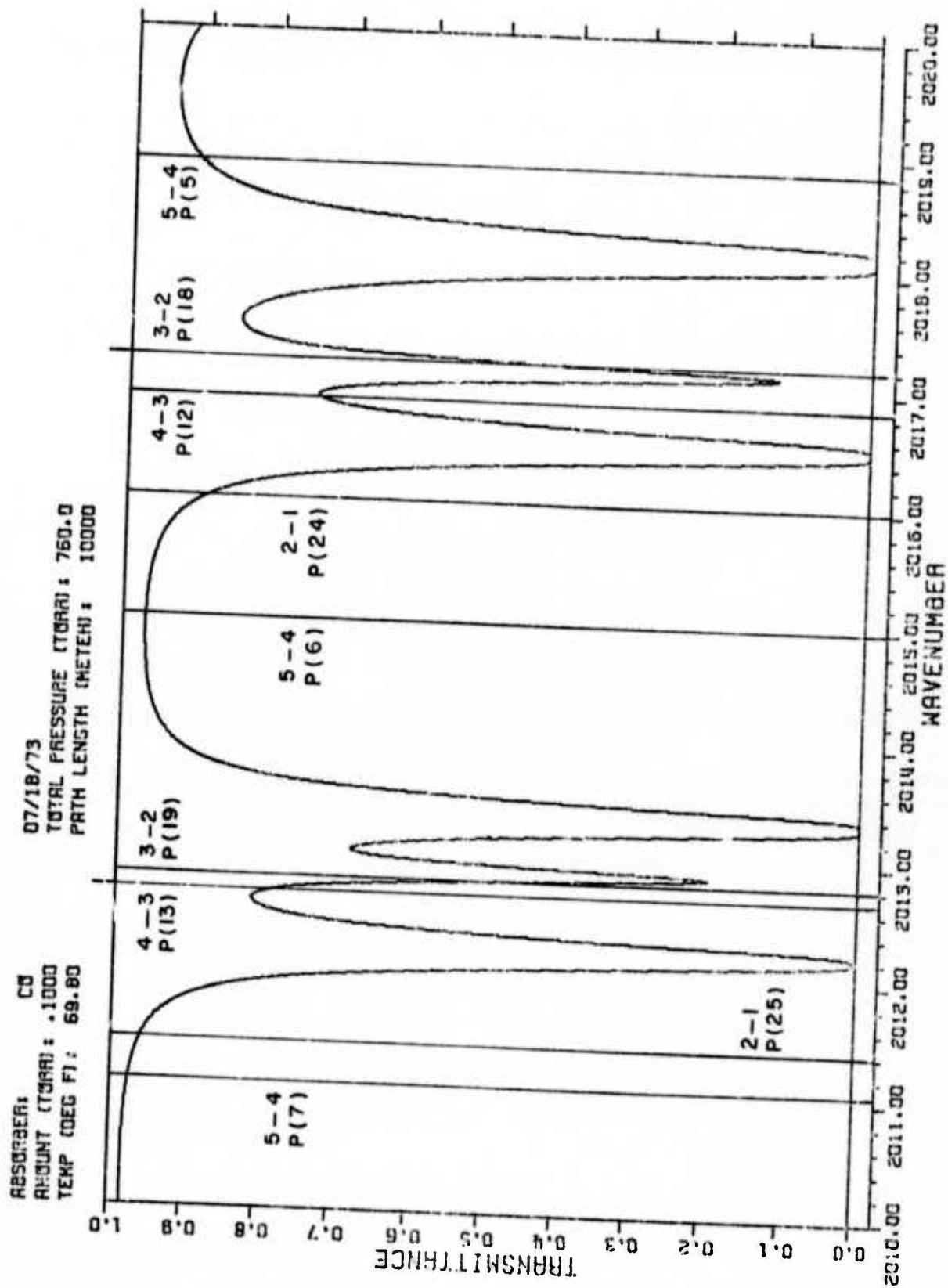
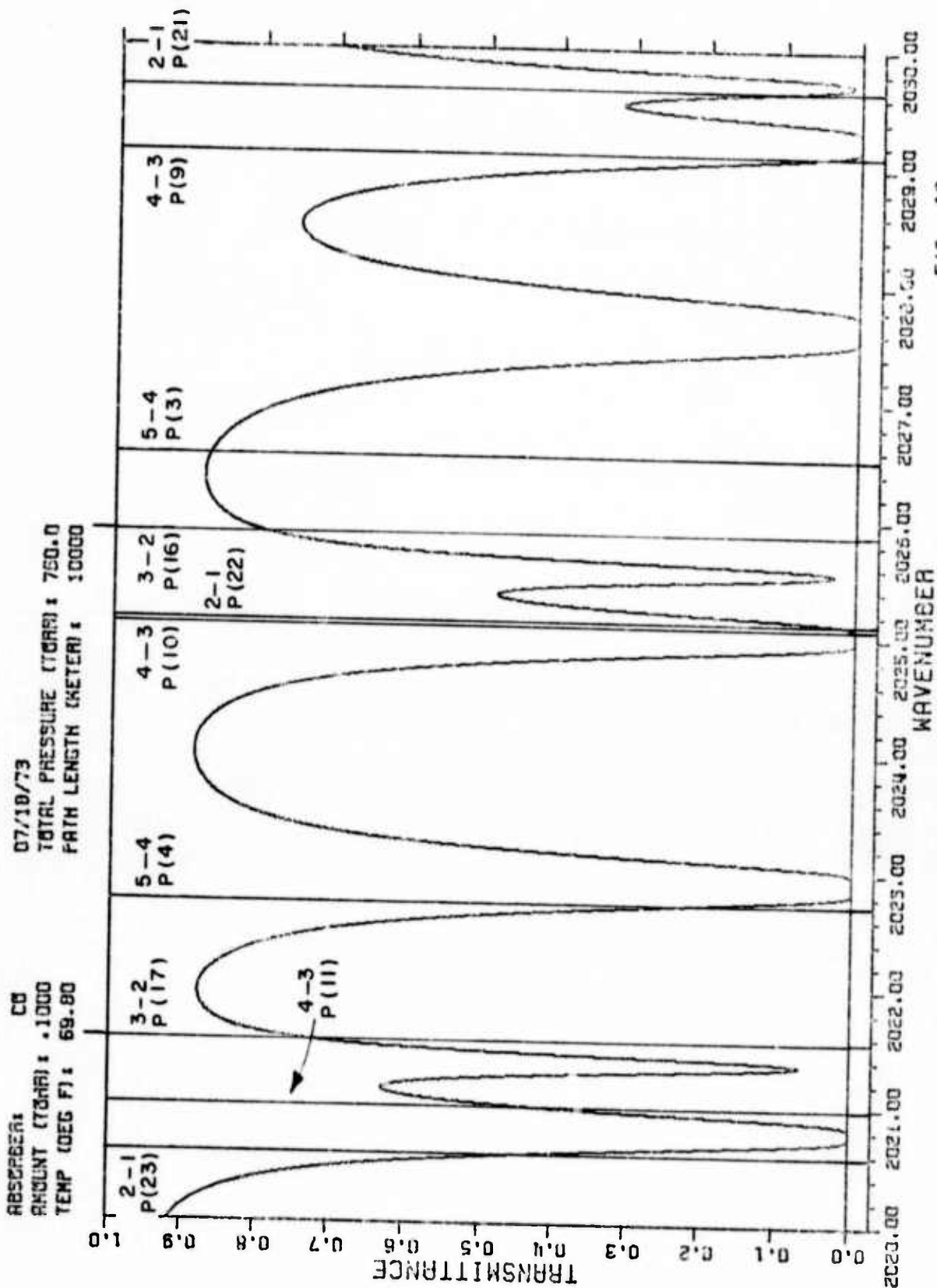


FIG. 39



ABSORBER: CO  
 AMOUNT (TORR): .1000  
 TEMP (DEG F): 69.60

07/18/73  
 TOTAL PRESSURE (TORR): 760.0  
 PATH LENGTH (METER): 10000

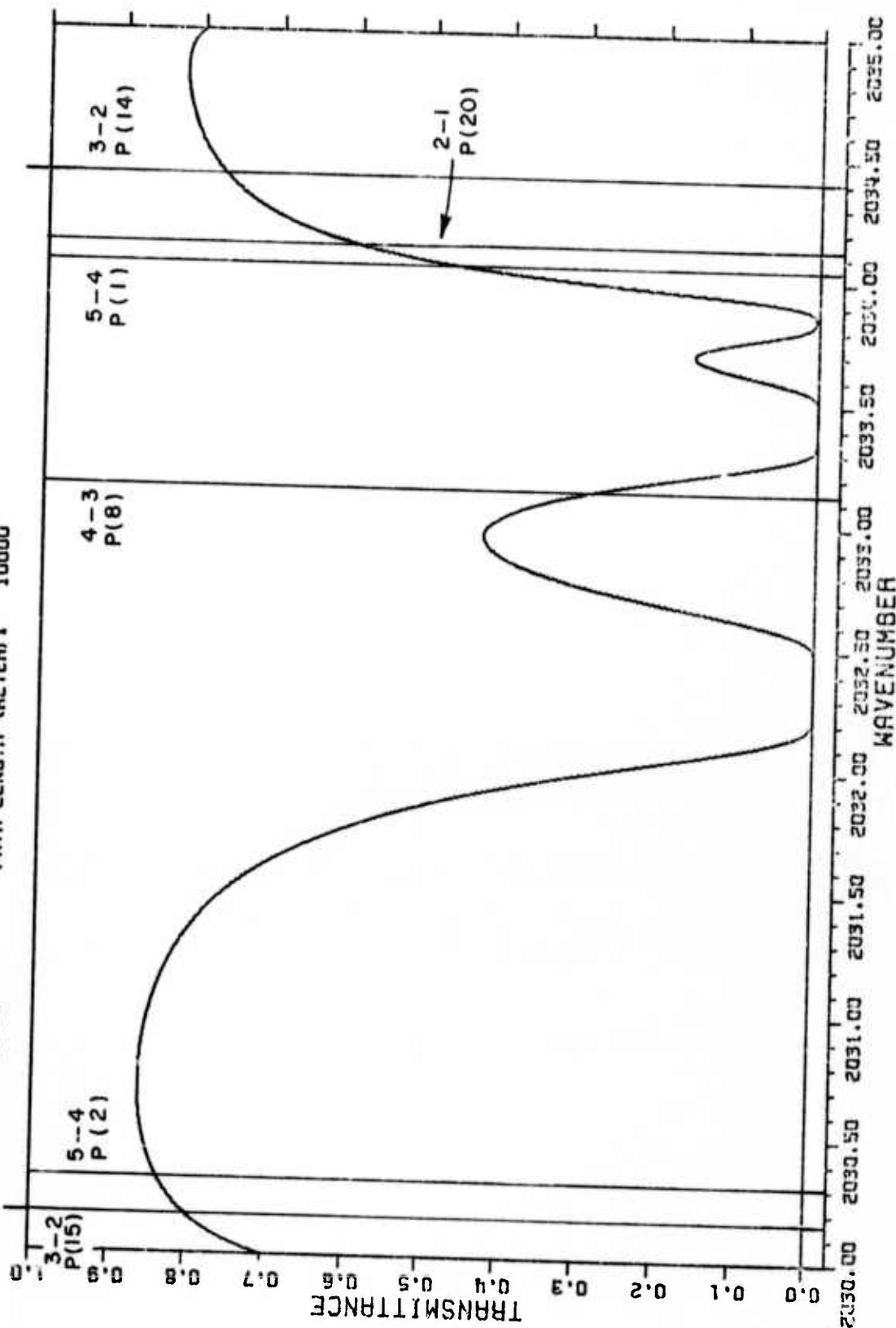


FIG. 41

ABSORBER: CB  
AMOUNT (TORR): 1.000  
TEMP (DEG F): 69.80

07/10/73  
TOTAL PRESSURE (TORR): 760.0  
PATH LENGTH (METER): 1000.

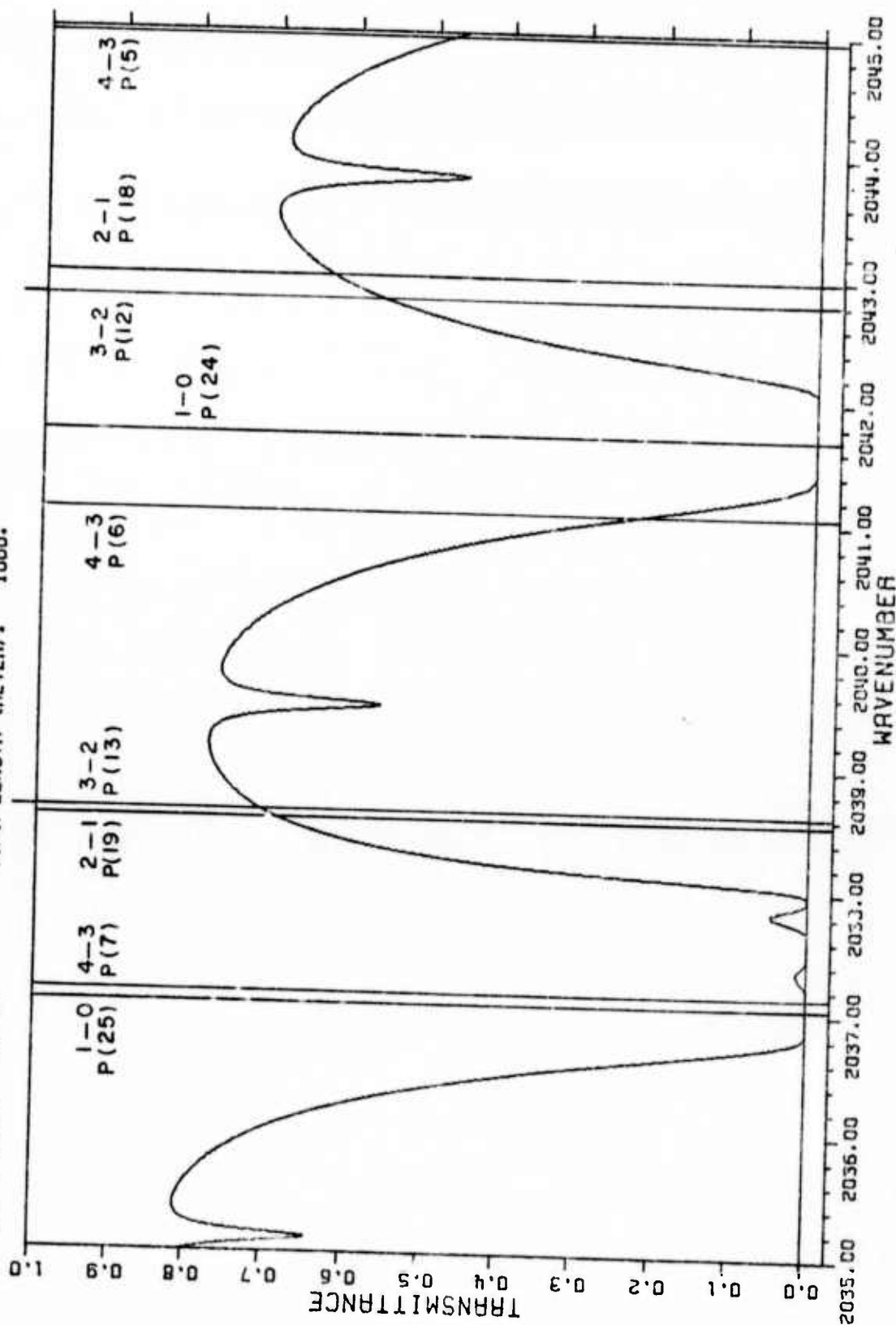


FIG. 42

ABSORBER: CO  
 AMOUNT (TORR): 1.000  
 TEMP (DEG F): 69.80  
 07/10/73  
 TOTAL PRESSURE (TORR): 760.0  
 PATH LENGTH (METER): 1000.

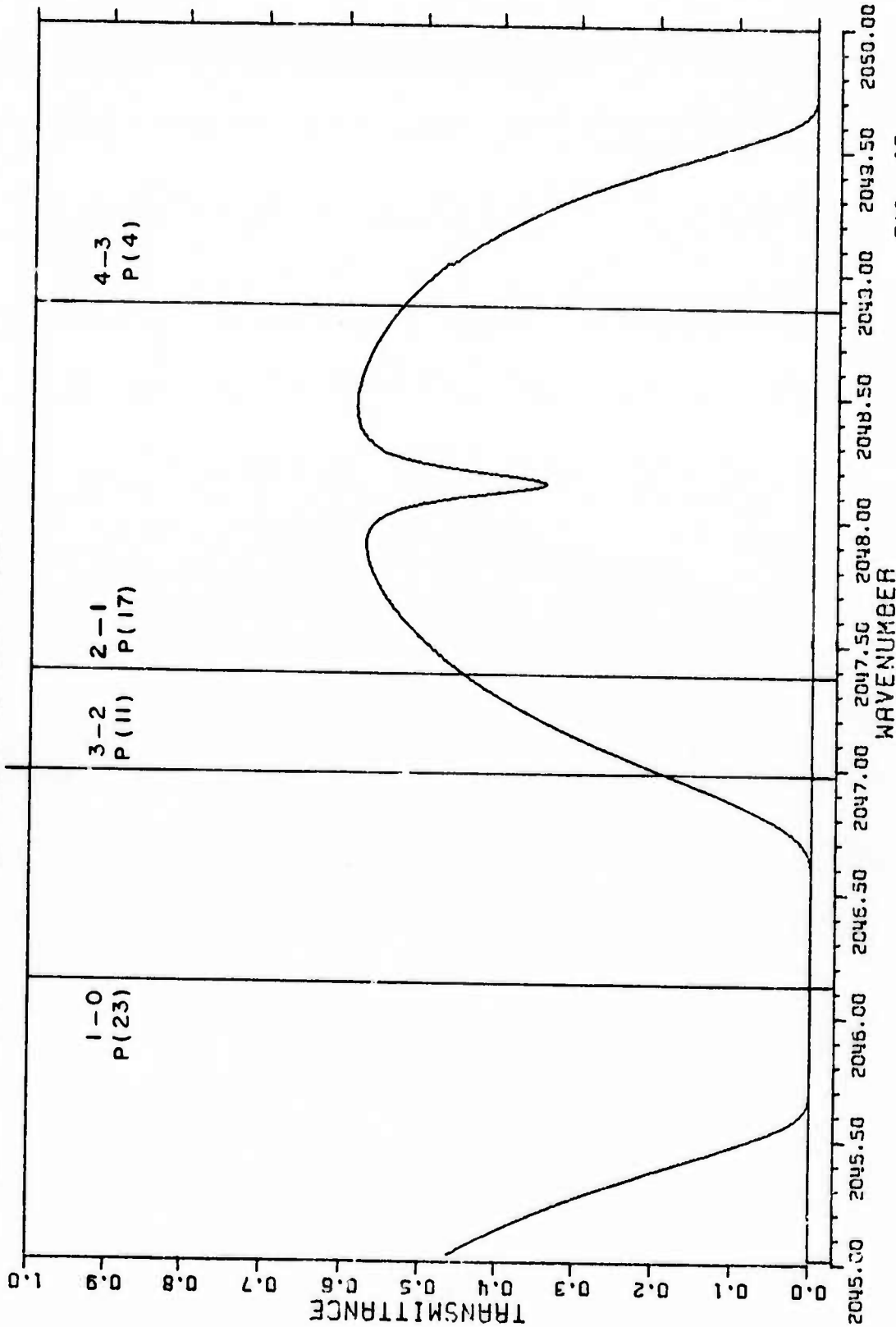


FIG. 43



ABSORBER: CD  
 AMOUNT (TORR): .0100  
 TEMP (DEG F): 69.80

07/10/73  
 TOTAL PRESSURE (TORR): 760.0  
 PATH LENGTH (METER): 1000.

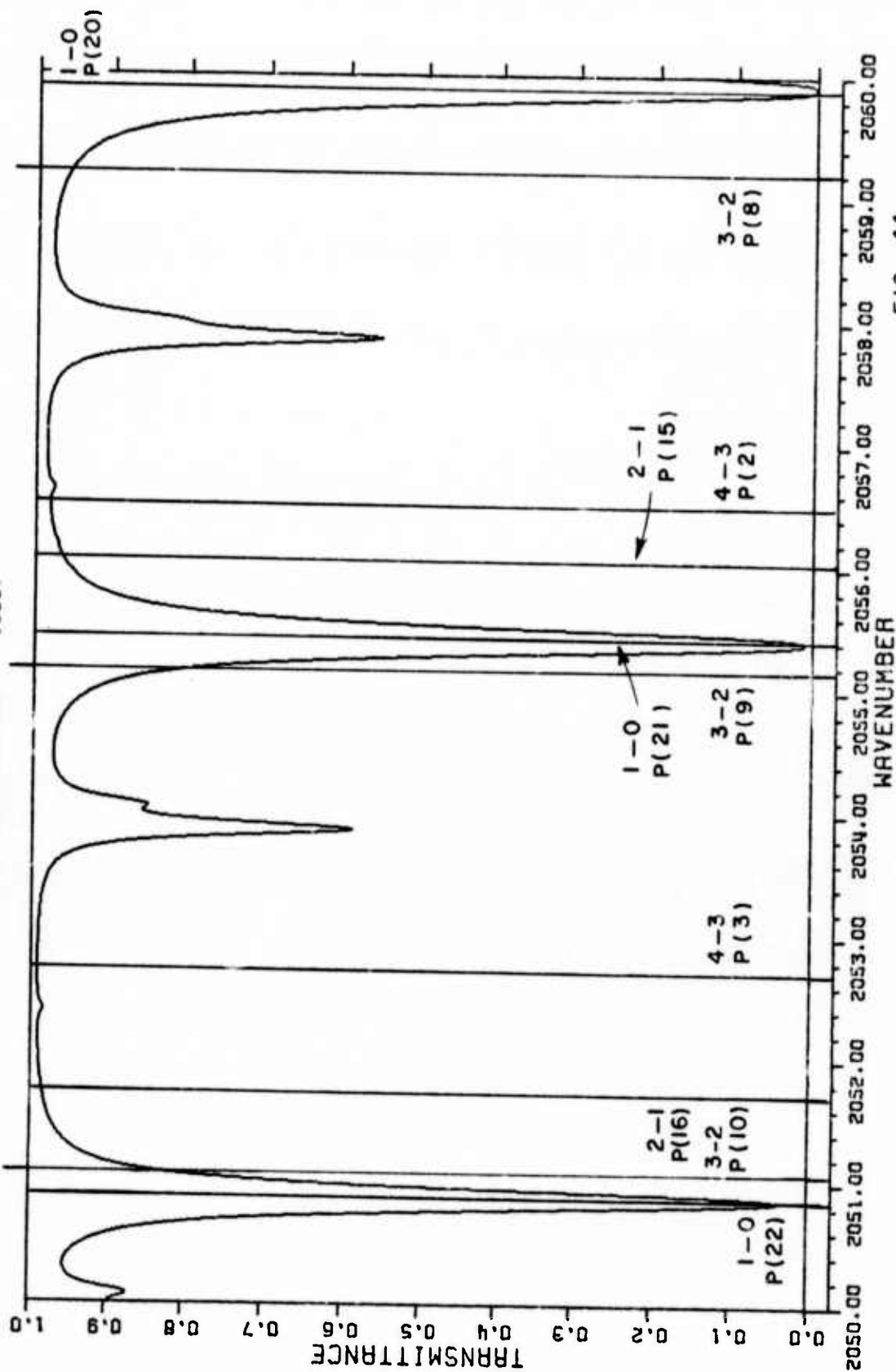


FIG. 44

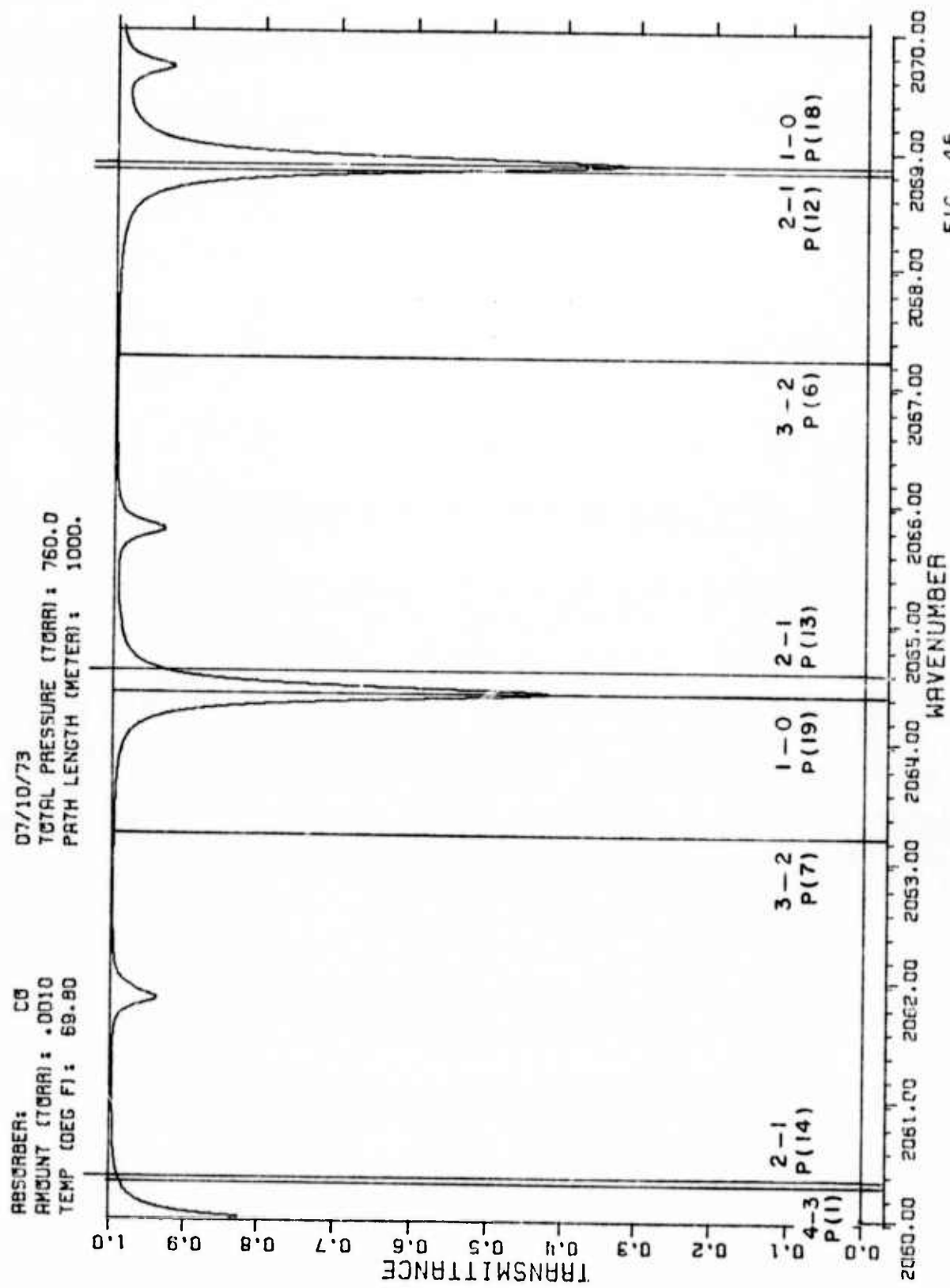


FIG. 45

ABSORBER: CO  
AMOUNT (TORR): .0010  
TEMP (DEG F): 69.60

07/15/73  
TOTAL PRESSURE (TORR): 760.0  
PATH LENGTH (METER): 1000.

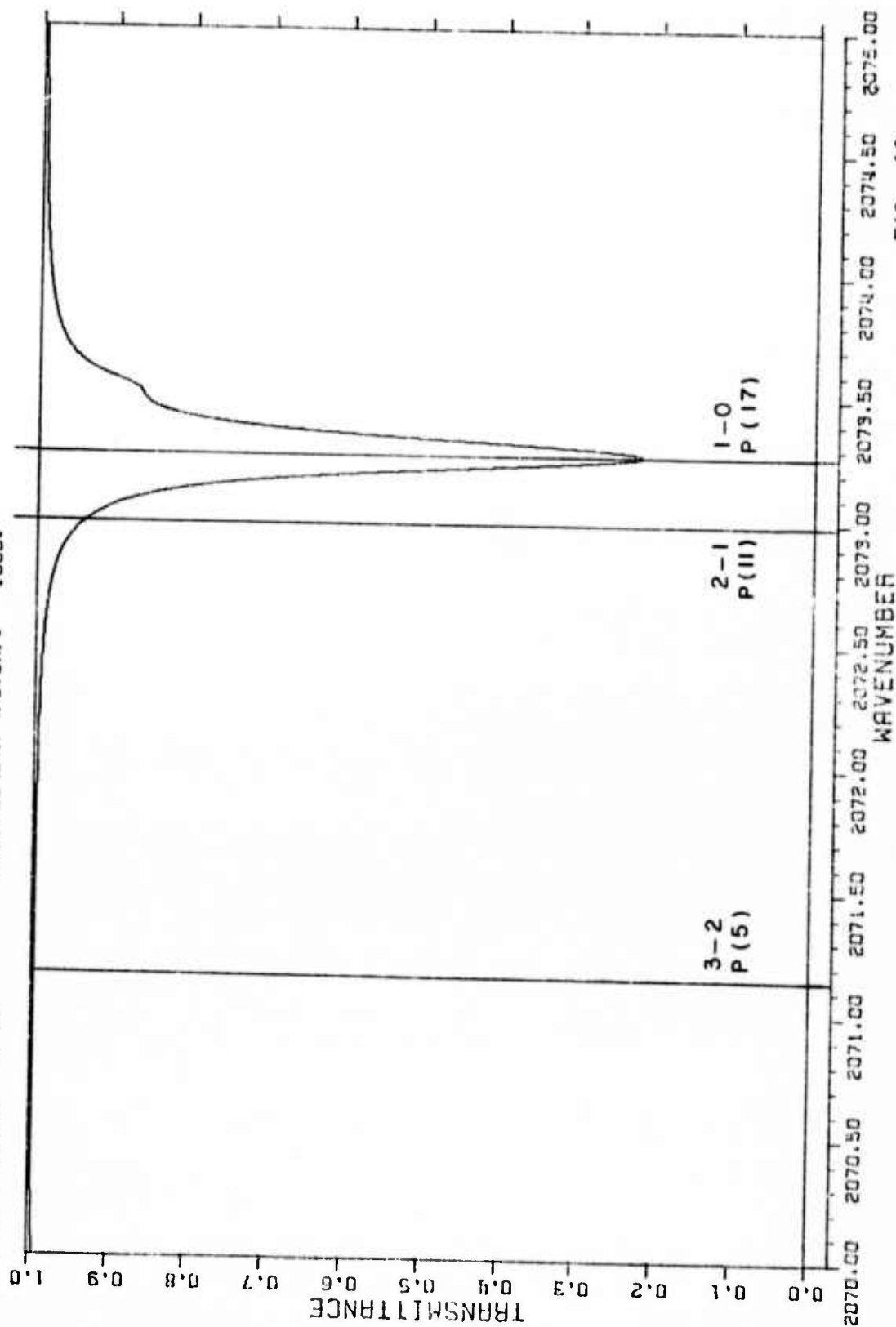


FIG. 46

ABSORBER: CO  
AMOUNT (TORR): .0010  
TEMP (DEG F): 69.80

07/10/79  
TOTAL PRESSURE (TORR): 760.0  
PATH LENGTH (METER): 1000.

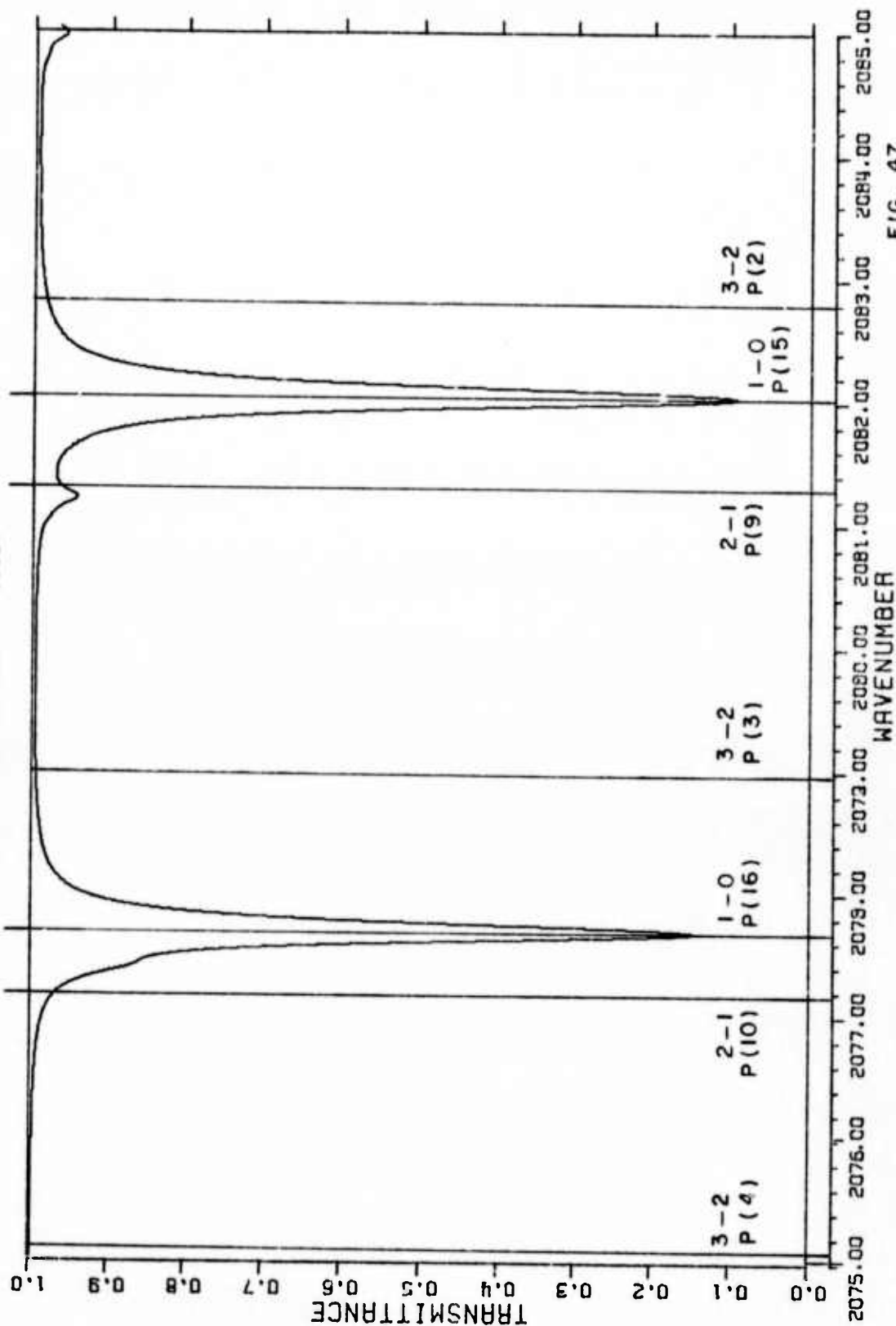


FIG. 47

FBSRBER: CB  
 AMOUNT (TCRAI): .0010  
 TEMP (DEC F): 69.80

07/11/73  
 TOTAL PRESSURE (TCRAI): 760.0  
 PATH LENGTH (METER): 1000.

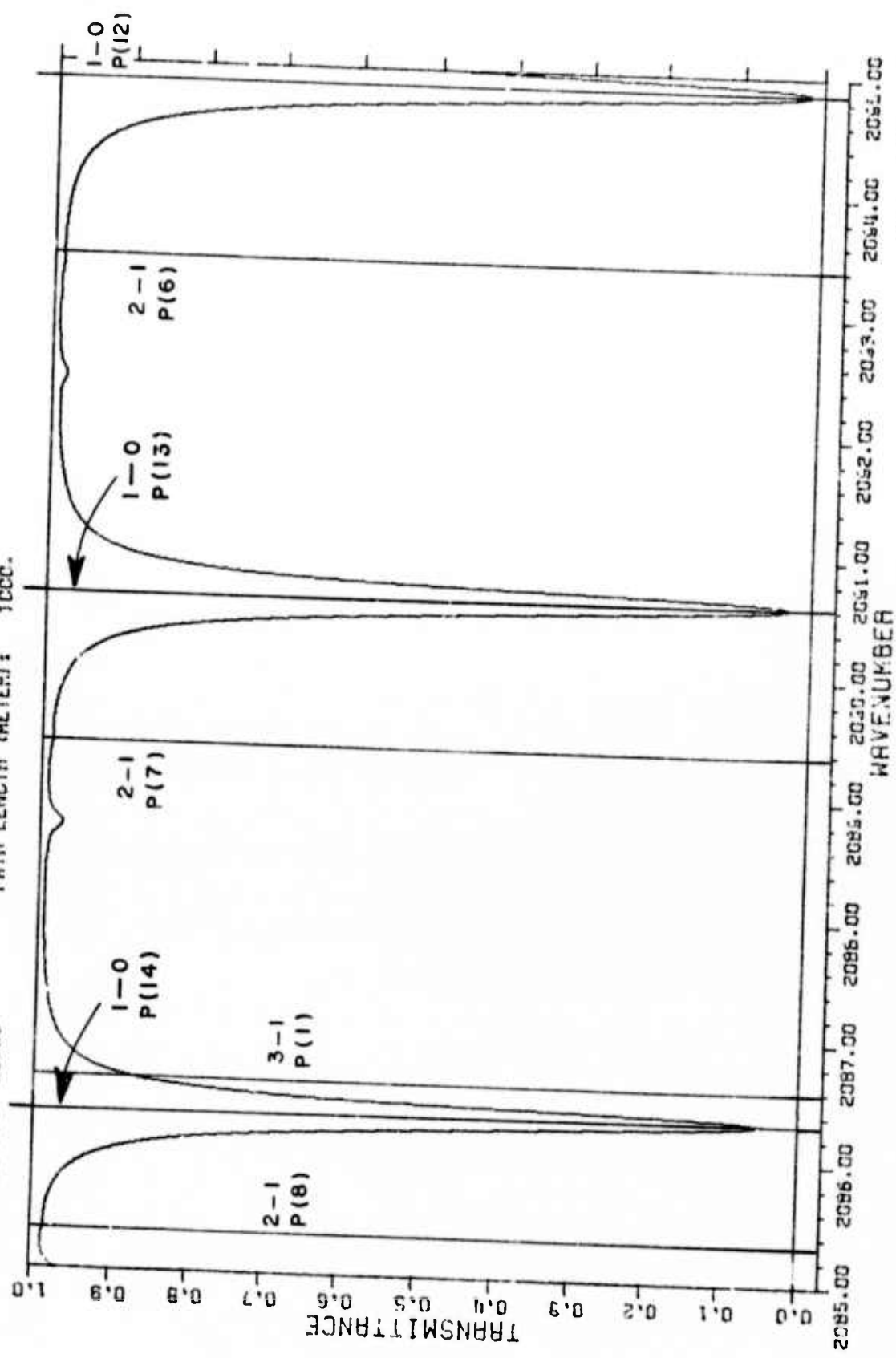


FIG. 48

ABSORBER: CO  
AMOUNT (TORR): .0010  
TEMP (DEG F): 69.80

C7/11/73  
TOTAL PRESSURE (TORR): 760.0  
PATH LENGTH (METER): 1000.

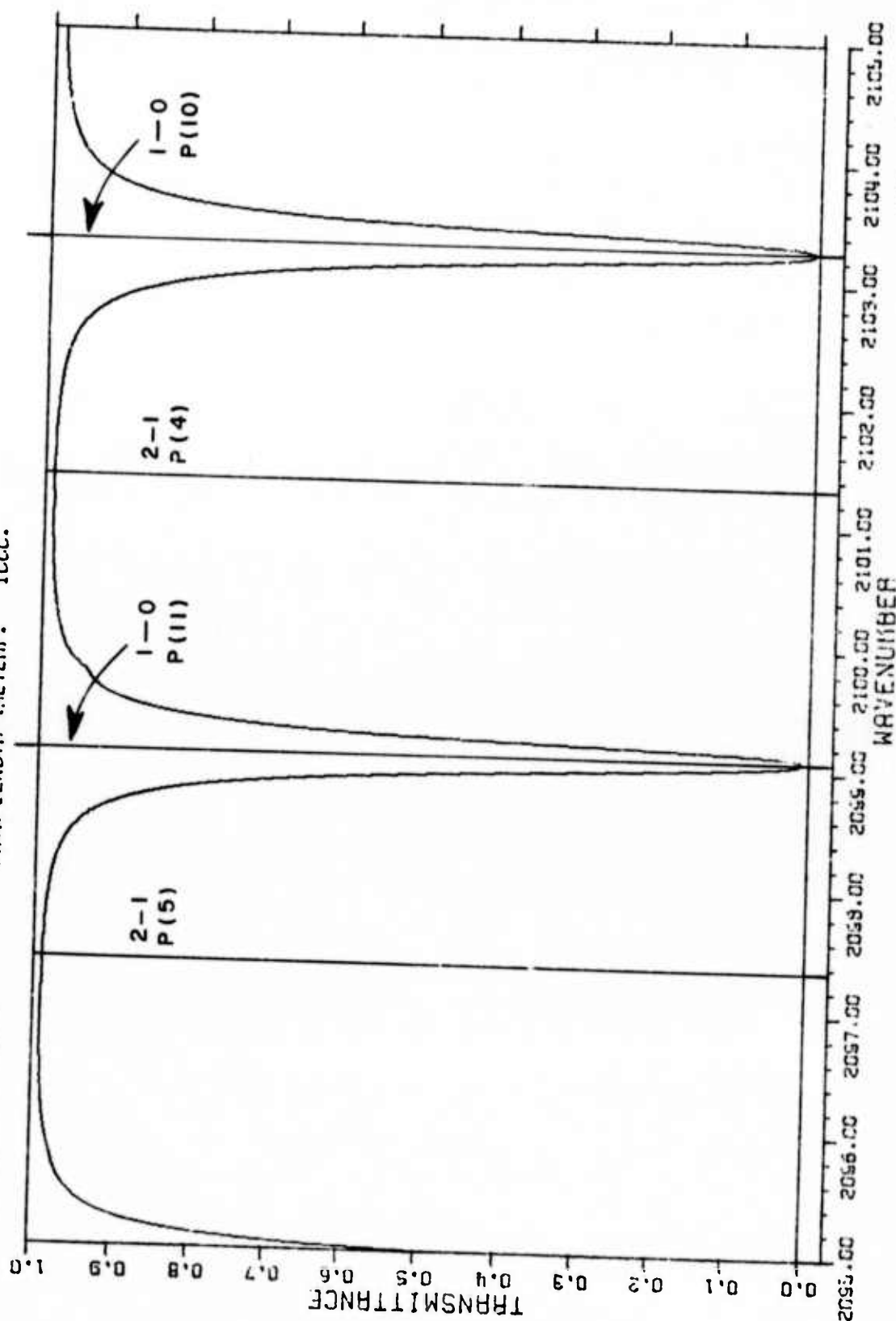


FIG. 49

ABSORBER: CO  
AMOUNT (TORR): .0001  
TEMP (DEG F): 69.80

07/10/73  
TOTAL PRESSURE (TORR): 760.0  
PATH LENGTH (METER): 1000.

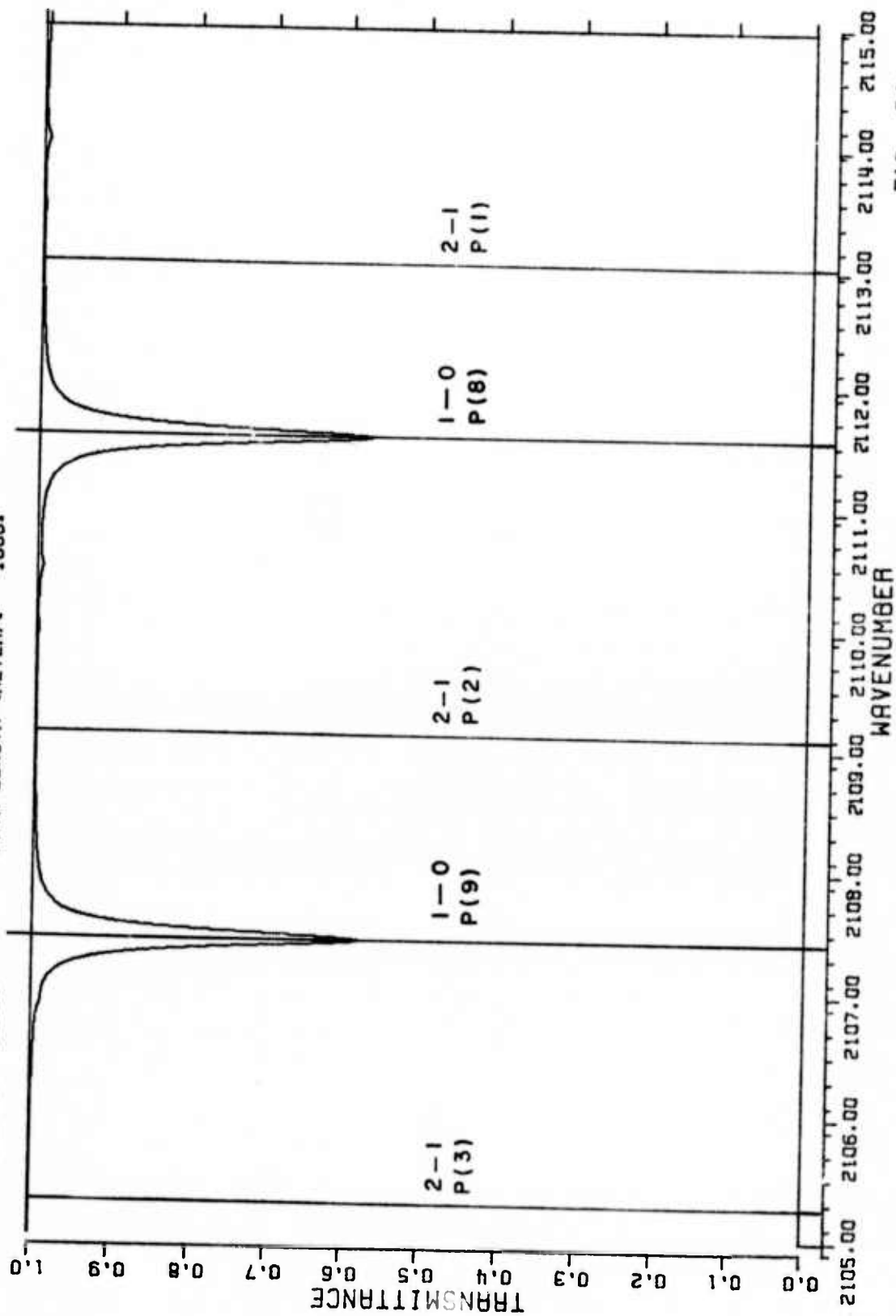


FIG. 50



ABSORBERS: H<sub>2</sub>O, CO<sub>2</sub>, CO  
AMOUNTS (TORR): 14.26, 0.251,  
5.7 E-5  
TEMP (DEG F): 69.80  
02/22/74  
TOTAL PRESSURE (TORR): 760.0  
PATH LENGTH (METER): 1000.

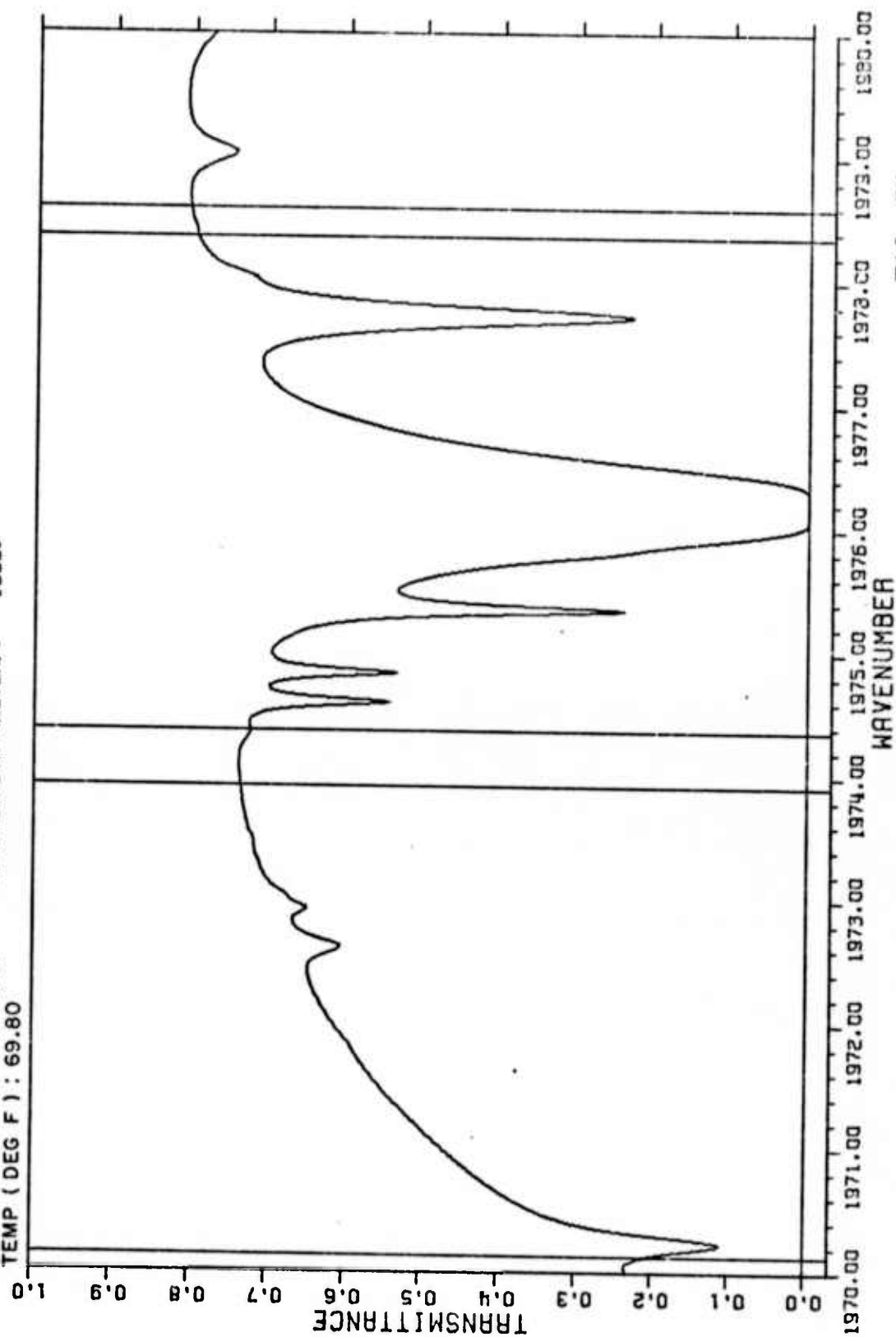


FIG. 51

ABSORBERS: H<sub>2</sub>O, CO<sub>2</sub>, CO  
AMOUNTS (TORR): 14.26, 0.251,  
5.7 E-5  
TEMP (DEG F): 69.80  
02/22/74  
TOTAL PRESSURE (TORR): 760.0  
PATH LENGTH (METER): 1000.

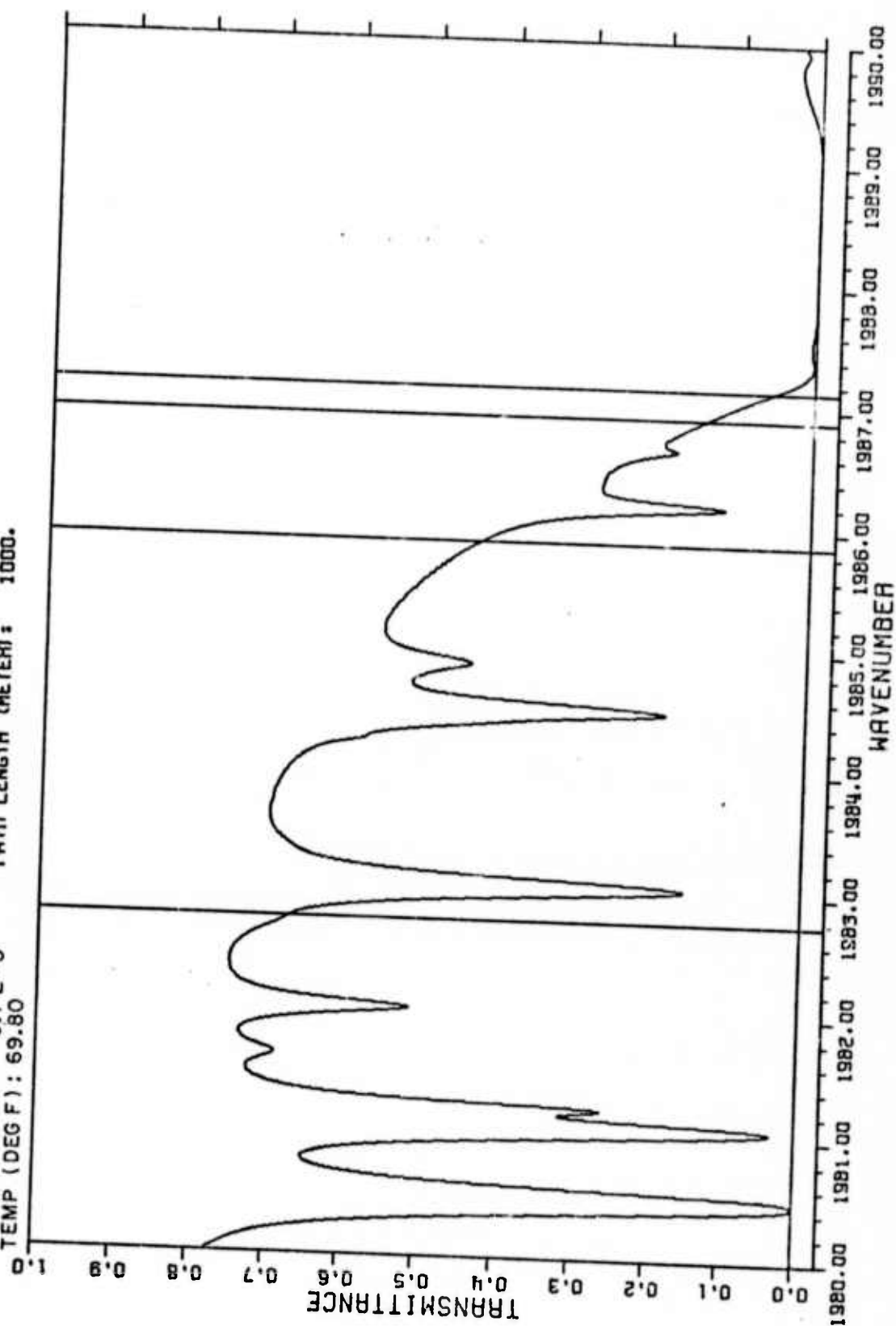


FIG. 52

ABSORBERS: H<sub>2</sub>O, CO<sub>2</sub>, CO 02/22/74  
AMOUNTS (TORR): 14.26, 0.251, TOTAL PRESSURE (TORR): 760.0  
5.7 E-5 PATH LENGTH (METER): 1000.  
TEMP (DEG F): 69.80

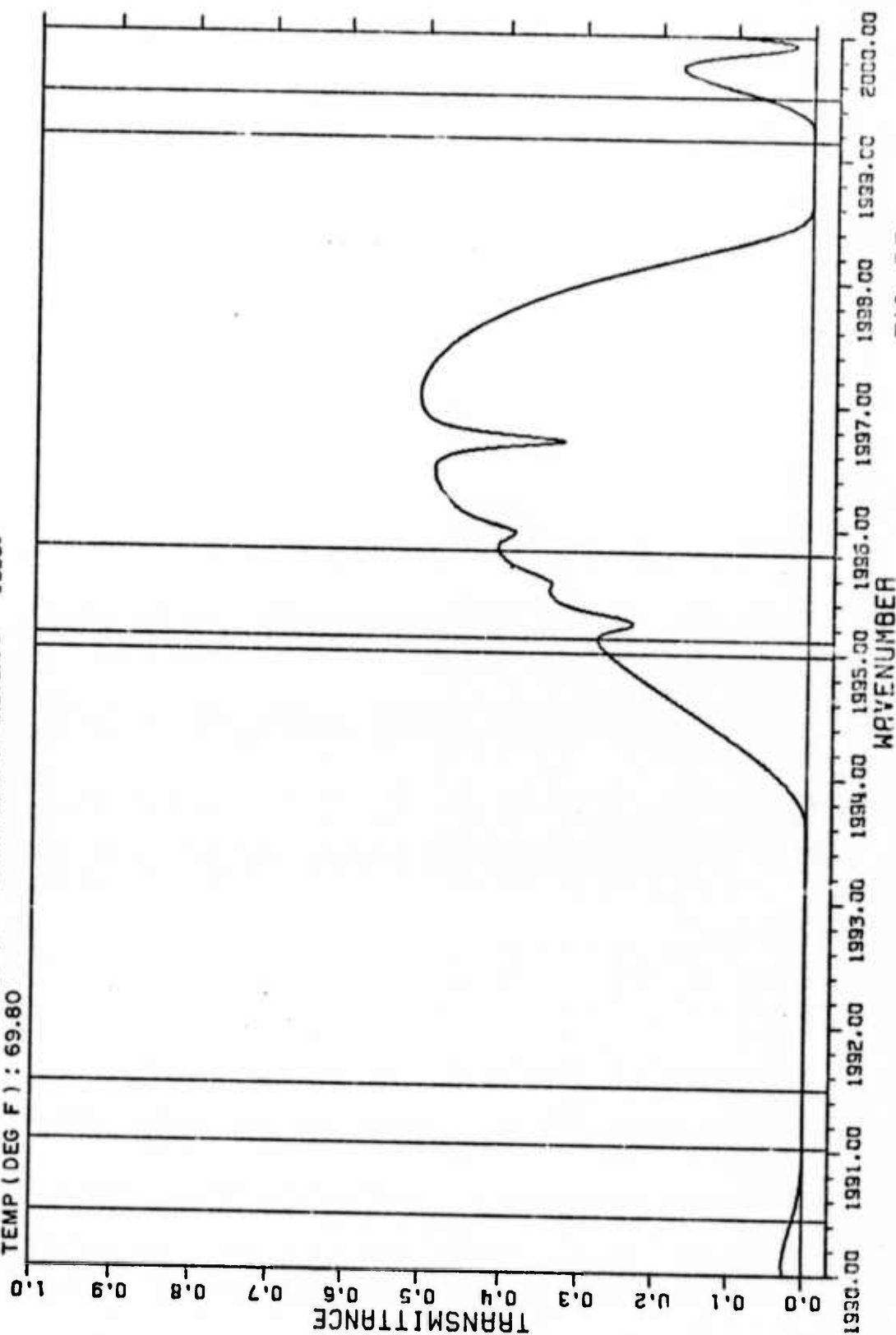


FIG. 53

ABSORBERS: H<sub>2</sub>O, CO<sub>2</sub>, CO  
AMOUNTS (TORR): 14.26, 0.251,  
5.7 E-5  
TEMP (DEG F): 69.80  
02/22/74  
TOTAL PRESSURE (TORR): 760.0  
PATH LENGTH (METER): 1000.

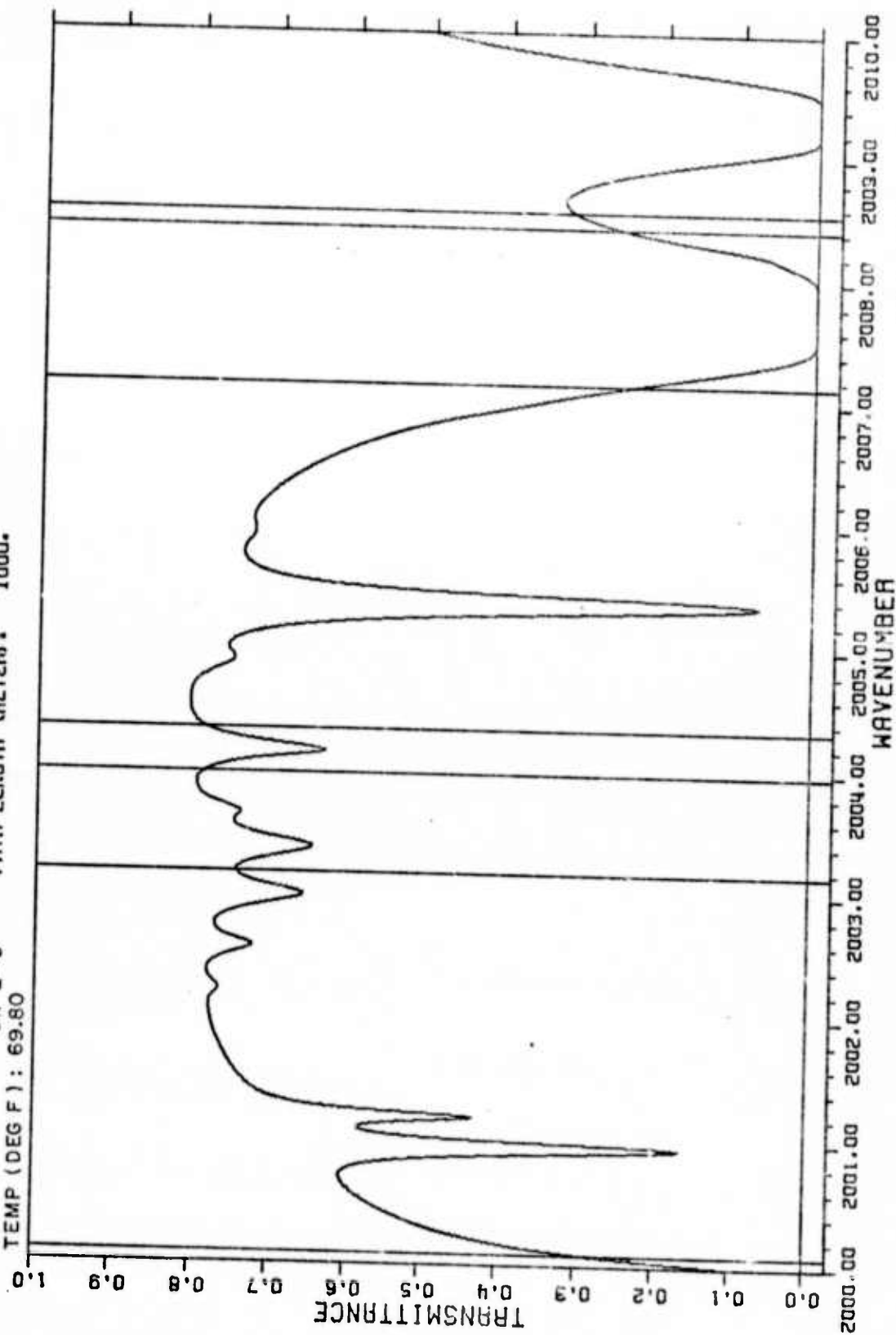


FIG. 54

ABSORBERS: H<sub>2</sub>O, CO<sub>2</sub>, CO  
AMOUNTS (TORR): 14.26, 0.251,  
5.7 E-5  
TEMP (DEG F): 69.80  
02/22/74  
TOTAL PRESSURE (TORR): 760.0  
PATH LENGTH (METER): 1000.

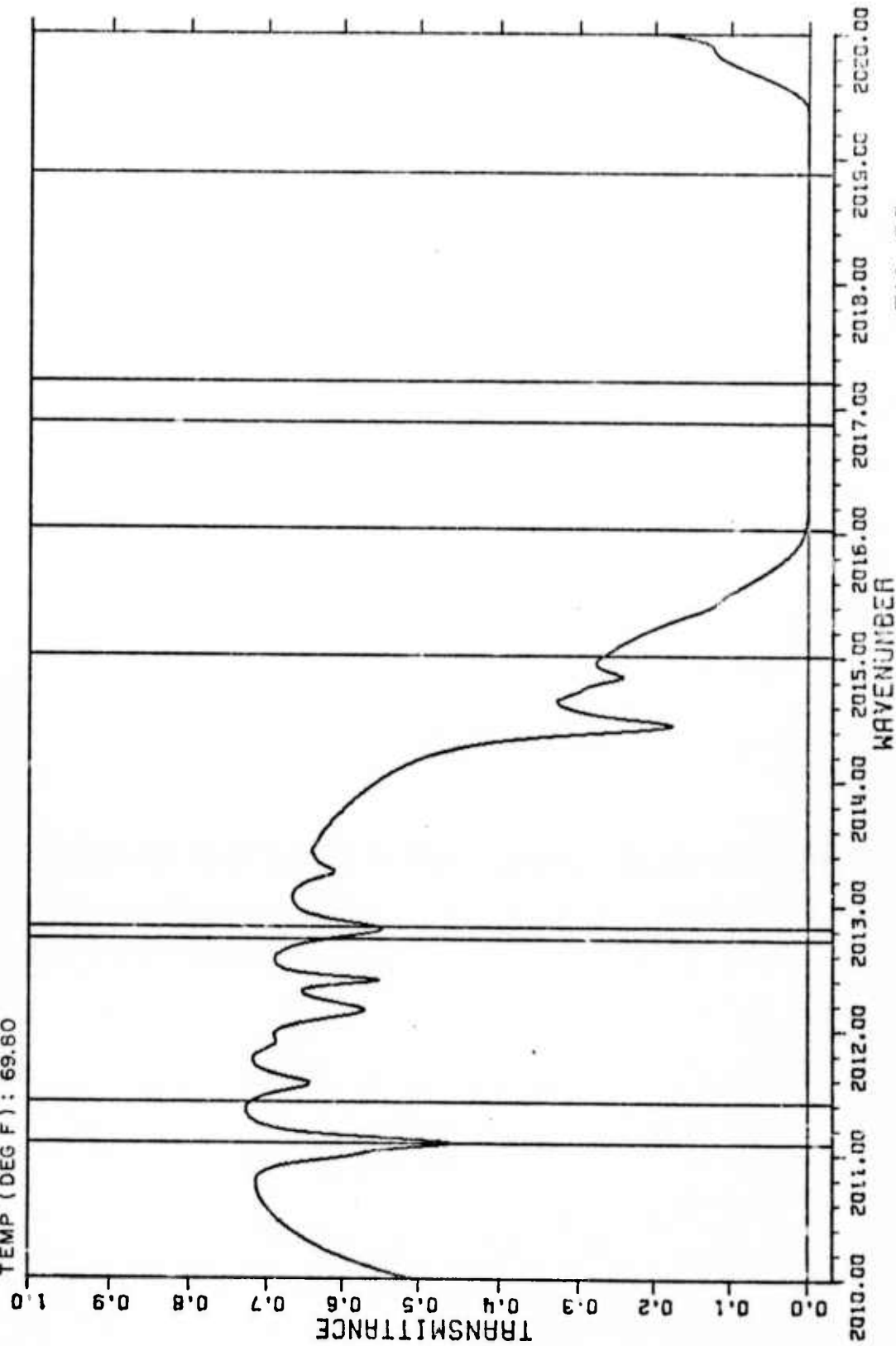


FIG. 55

ABSORBERS: H<sub>2</sub>O, CO<sub>2</sub>, CO  
 AMOUNTS (TORR): 14.26, 0.251,  
 5.7E-5  
 TEMP (DEG F): 69.60  
 02/22/74  
 TOTAL PRESSURE (TORR): 760.0  
 PATH LENGTH (METER): 1000.

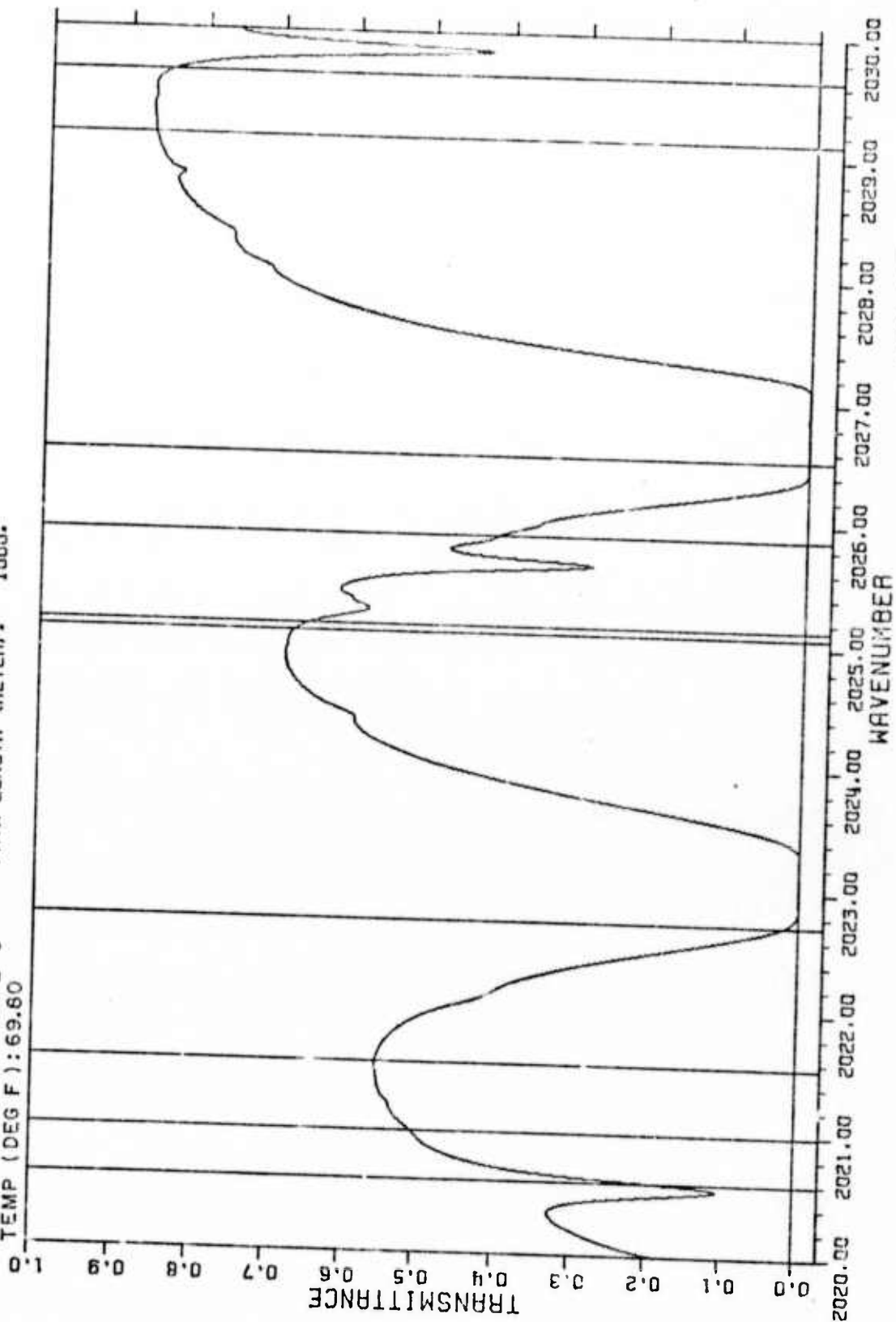
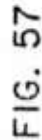


FIG. 56

02/22/74





ABSORBERS: H<sub>2</sub>O, CO<sub>2</sub>, CO  
 AMOUNTS (TORR): 14.26, 0.251, 5.7 E-5  
 TEMP (DEG F): 69.80  
 02/22/74  
 TOTAL PRESSURE (TORR): 760.0  
 PATH LENGTH (METER): 1000.

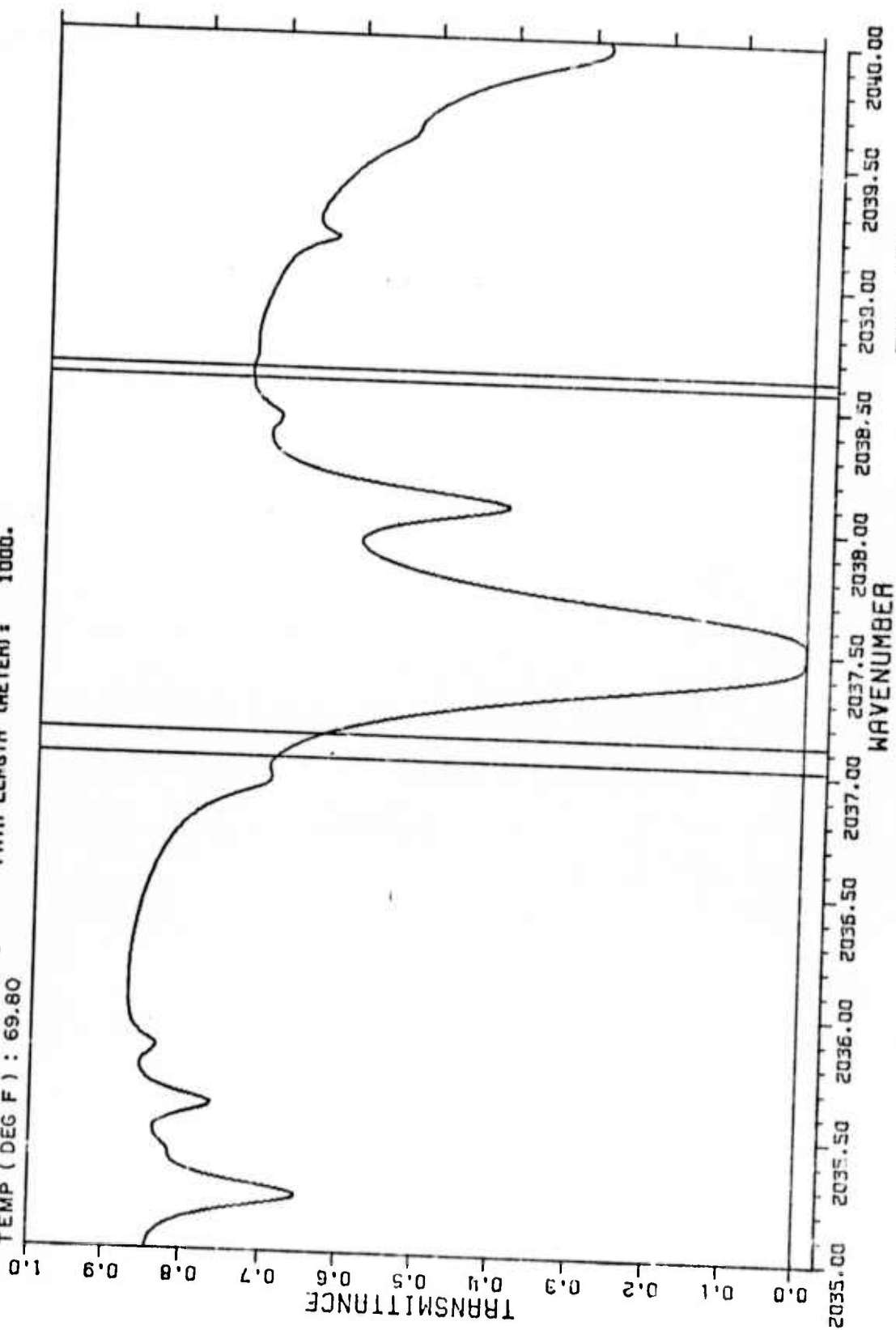


FIG. 58

ABSORBERS: H<sub>2</sub>O, CO<sub>2</sub>, CO  
AMOUNTS (TORR): 14.26, 0.251,  
5.75-5  
TEMP (DEG F): 69.80  
02/22/74  
TOTAL PRESSURE (TORR): 760.0  
PATH LENGTH (METER): 1000.

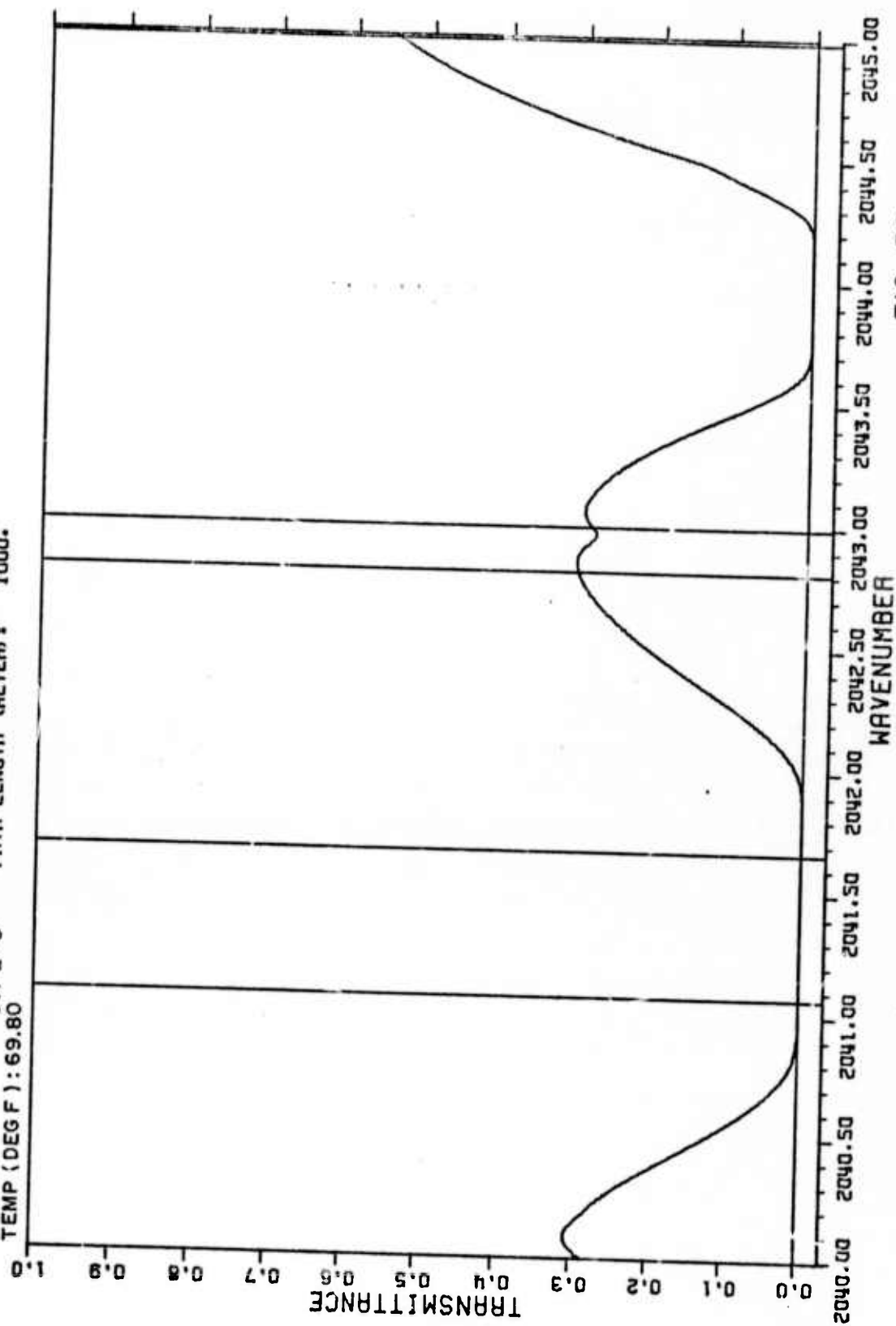


FIG. 59

ABSORBERS: H<sub>2</sub>O, CO<sub>2</sub>, CO  
AMOUNTS (TORR): 14.26, 0.251,  
5.7E-5  
TEMP (DEG F): 69.80  
02/22/74  
TOTAL PRESSURE (TORR): 760.0  
PATH LENGTH (METERS): 1000.

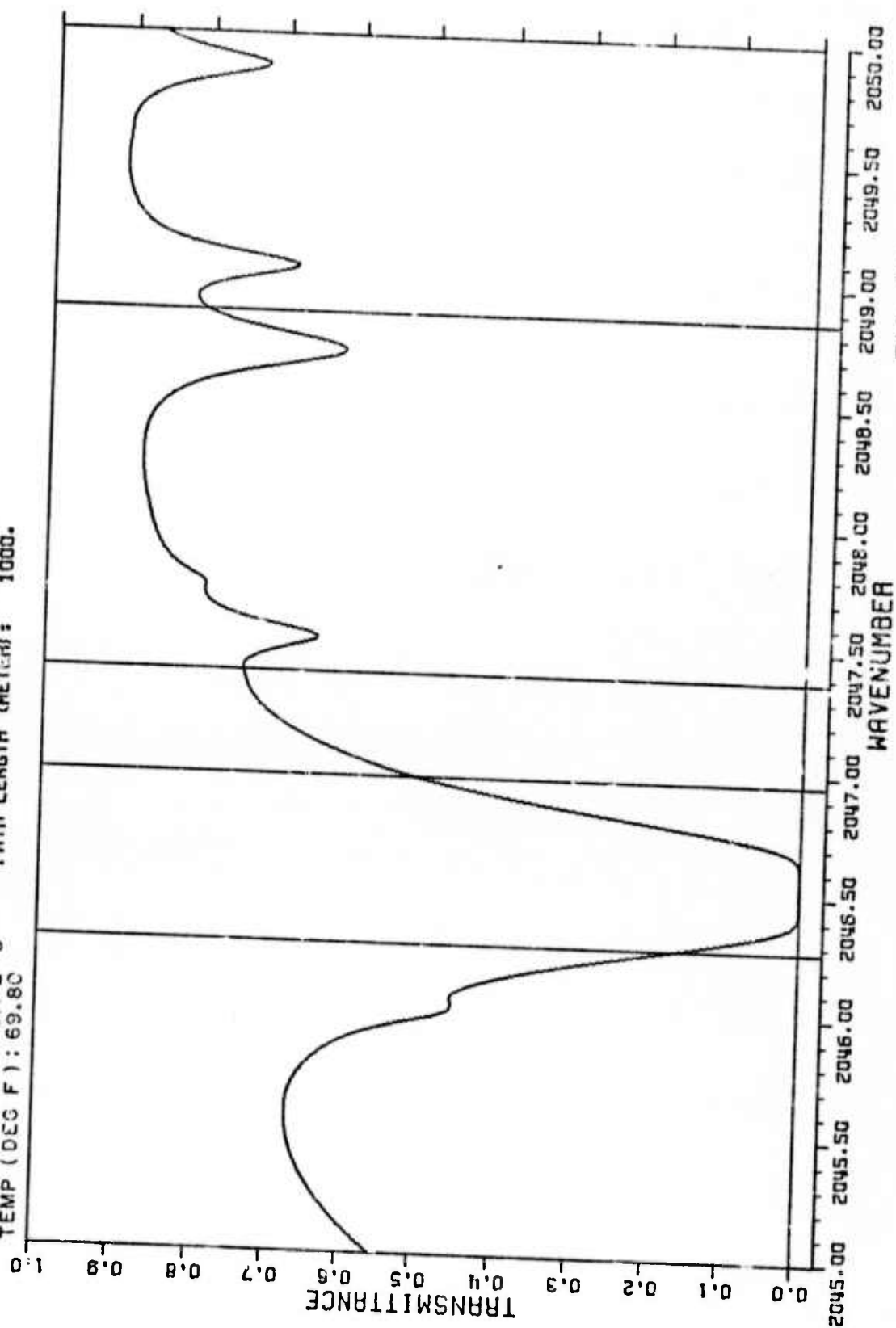


FIG. 60

ABSORBERS: H<sub>2</sub>O, CO<sub>2</sub>, CO 02/24/74  
AMOUNTS (TORR): 14.26, 0.251, TOTAL PRESSURE (TORR): 760.0  
5.7 E-5 PATH LENGTH (METER): 1000.  
TEMP (DEG F): 69.80

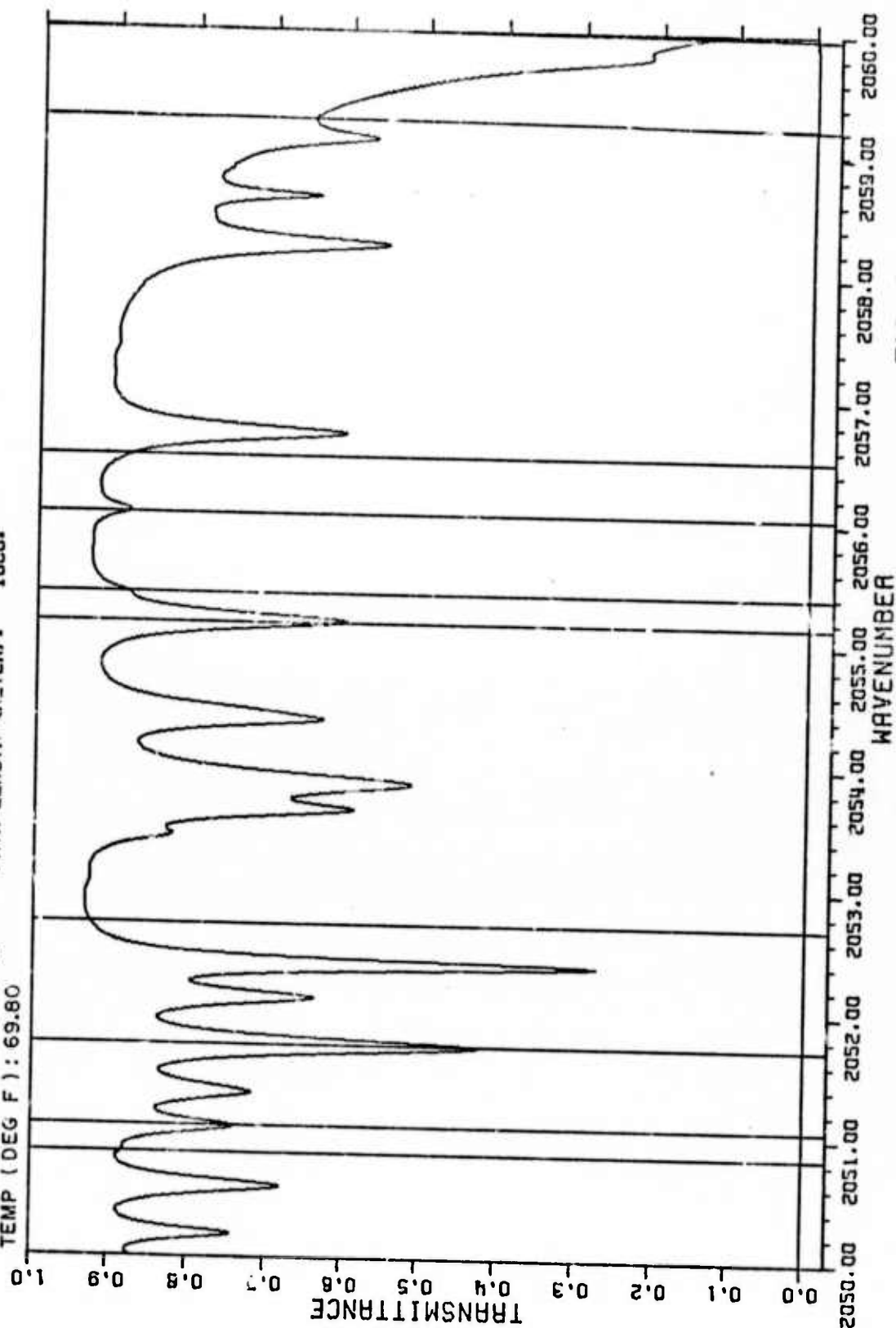


FIG. 61

ABSORBERS: H<sub>2</sub>O, CO<sub>2</sub>, CO  
 AMOUNTS (TORR): 14.26, 0.251,  
 5.7E-5  
 TEMP (DEG F): 69.80  
 02/24/74  
 TOTAL PRESSURE (TORR): 760.0  
 PATH LENGTH (METER): 1000.

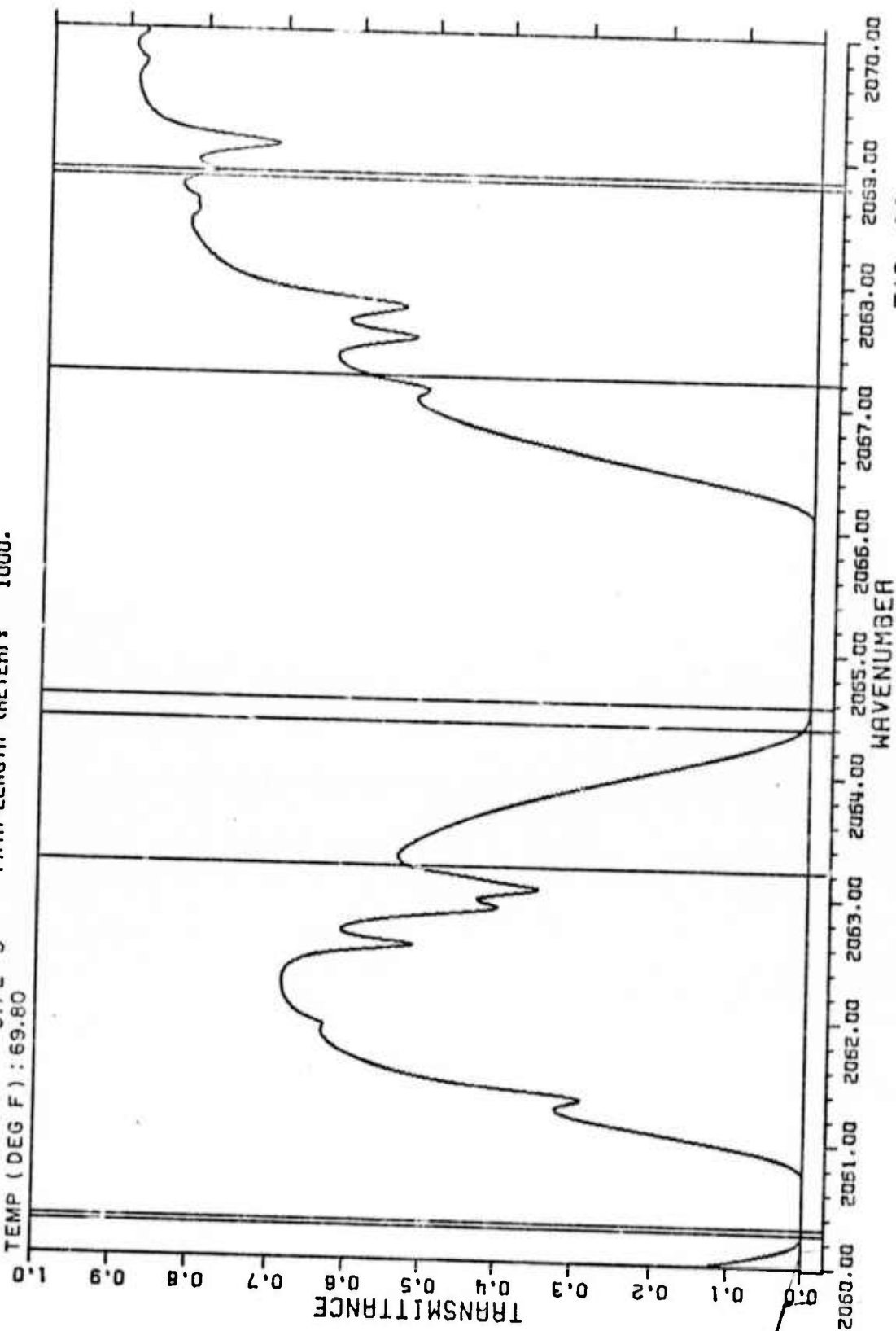


FIG. 62

ABSORBERS: H<sub>2</sub>O, CO<sub>2</sub>, CO  
AMOUNTS (TORR): 14.26, 0.251, 5.7E-5  
TEMP (DEG F): 69.80  
02/24/74  
TOTAL PRESSURE (TORR): 760.0  
PATH LENGTH (METER): 1000.

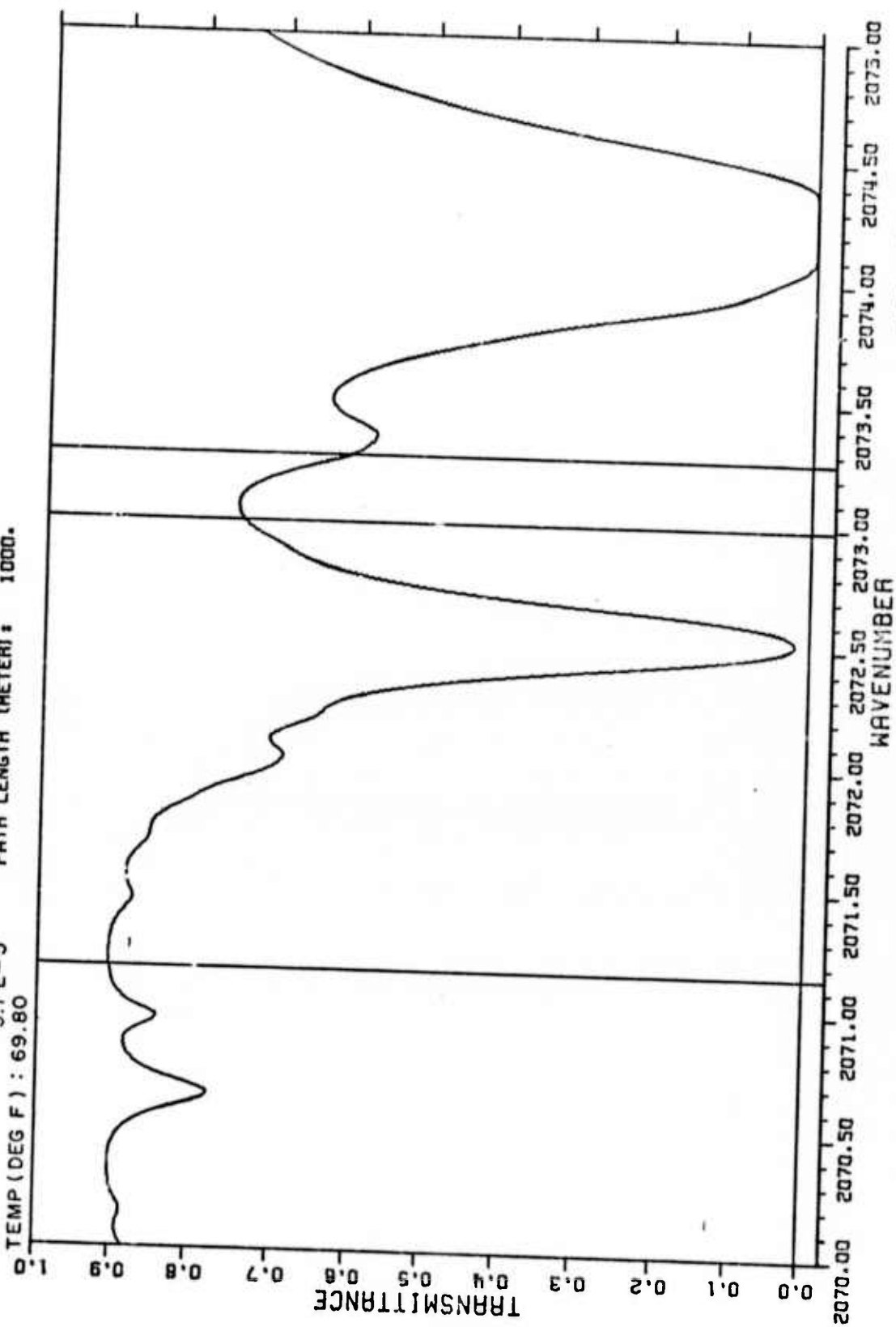


FIG. 63

ABSORBERS: H<sub>2</sub>O, CO<sub>2</sub>, CO  
AMOUNTS (TORR): 14.26, 0.251, 5.7 E-5  
TEMP (DEG F): 69.80  
TOTAL PRESSURE (TORR): 760.0  
PATH LENGTH (METER): 1000.

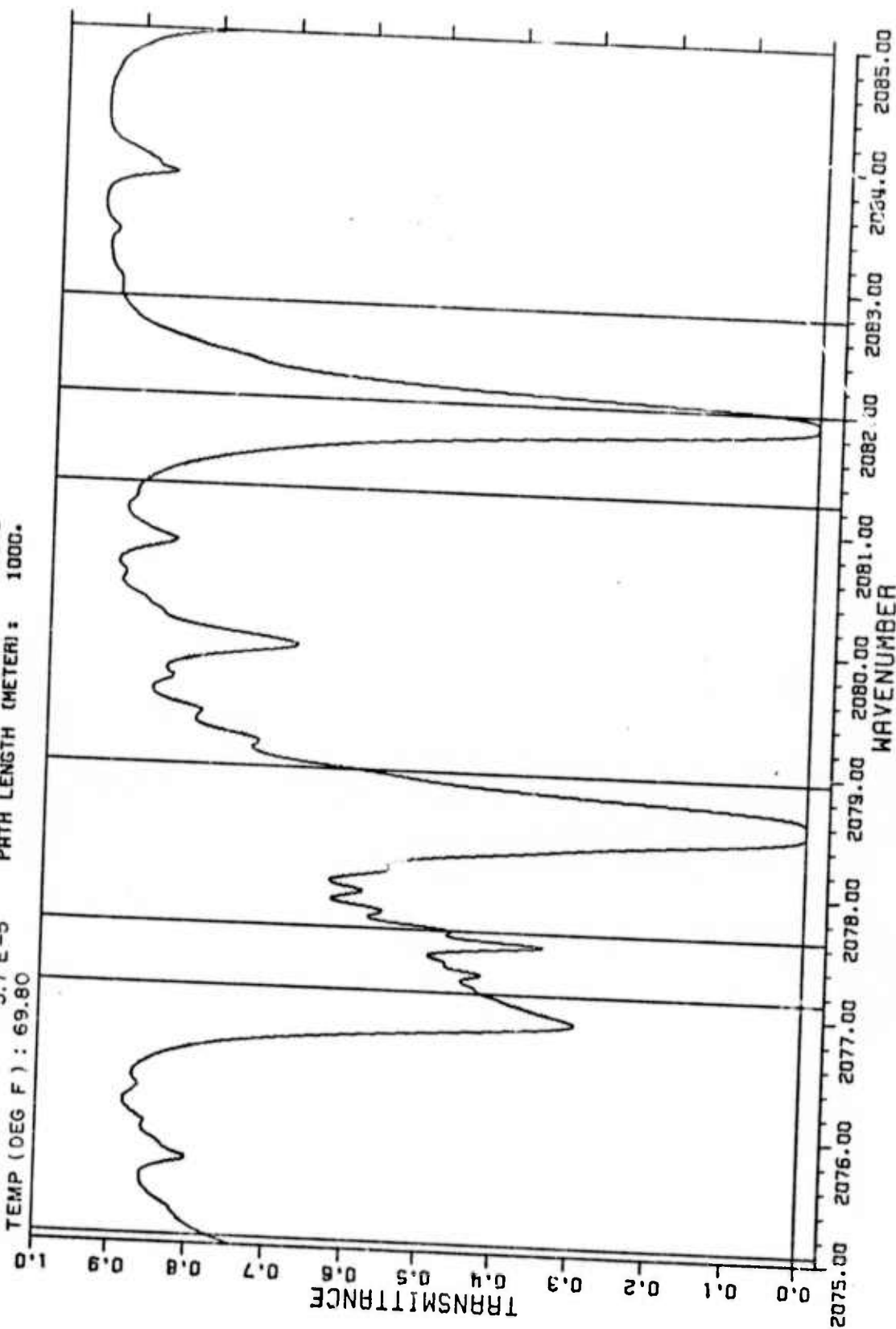


FIG. 64



ABSORBERS: H<sub>2</sub>O, CO<sub>2</sub>, CO  
 AMOUNTS (TORR): 14.26, 0.251, 5.7 E-5  
 TEMP (DEG F): 69.80  
 02/24/74  
 TOTAL PRESSURE (TORR): 760.0  
 PATH LENGTH (METER): 1000.

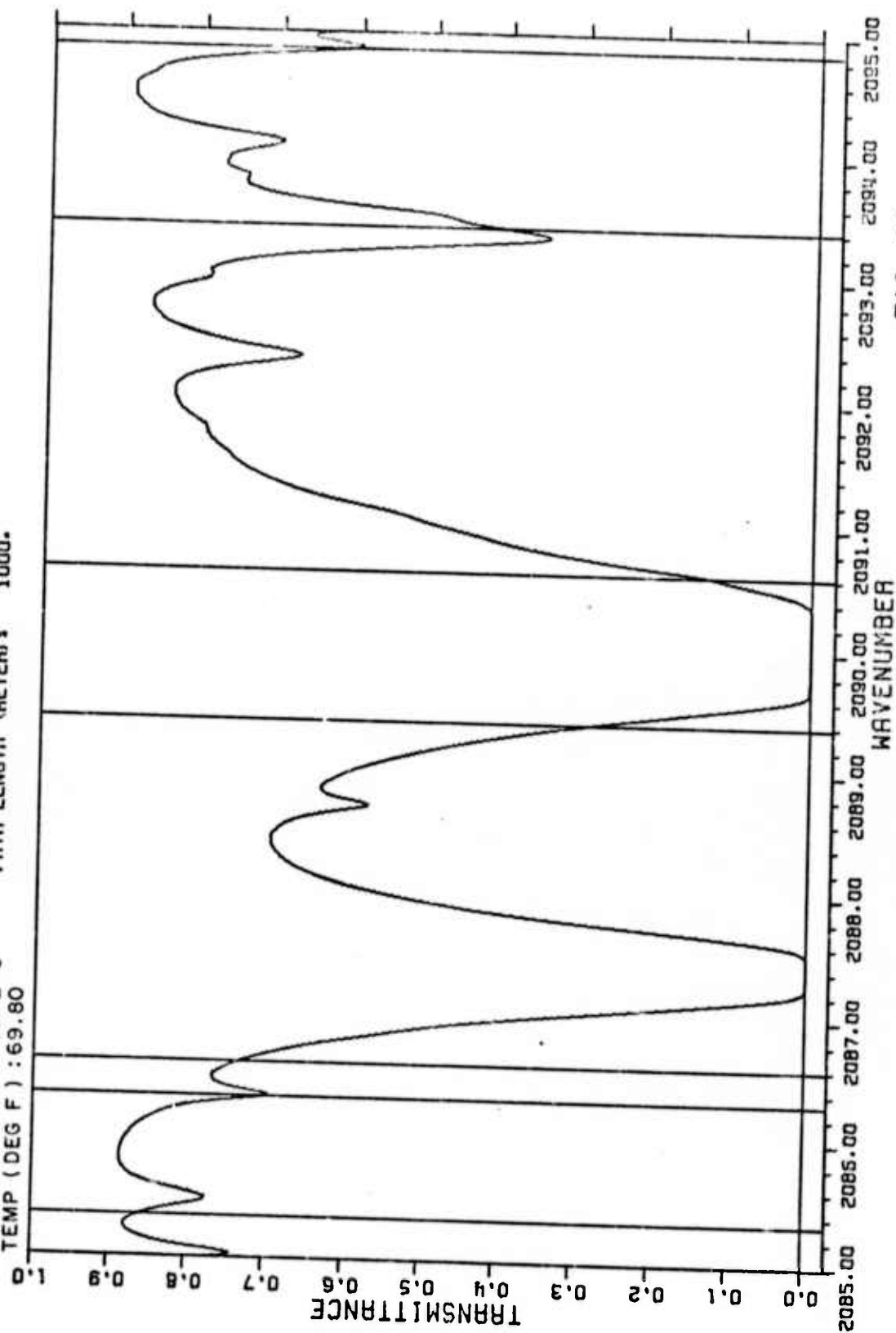
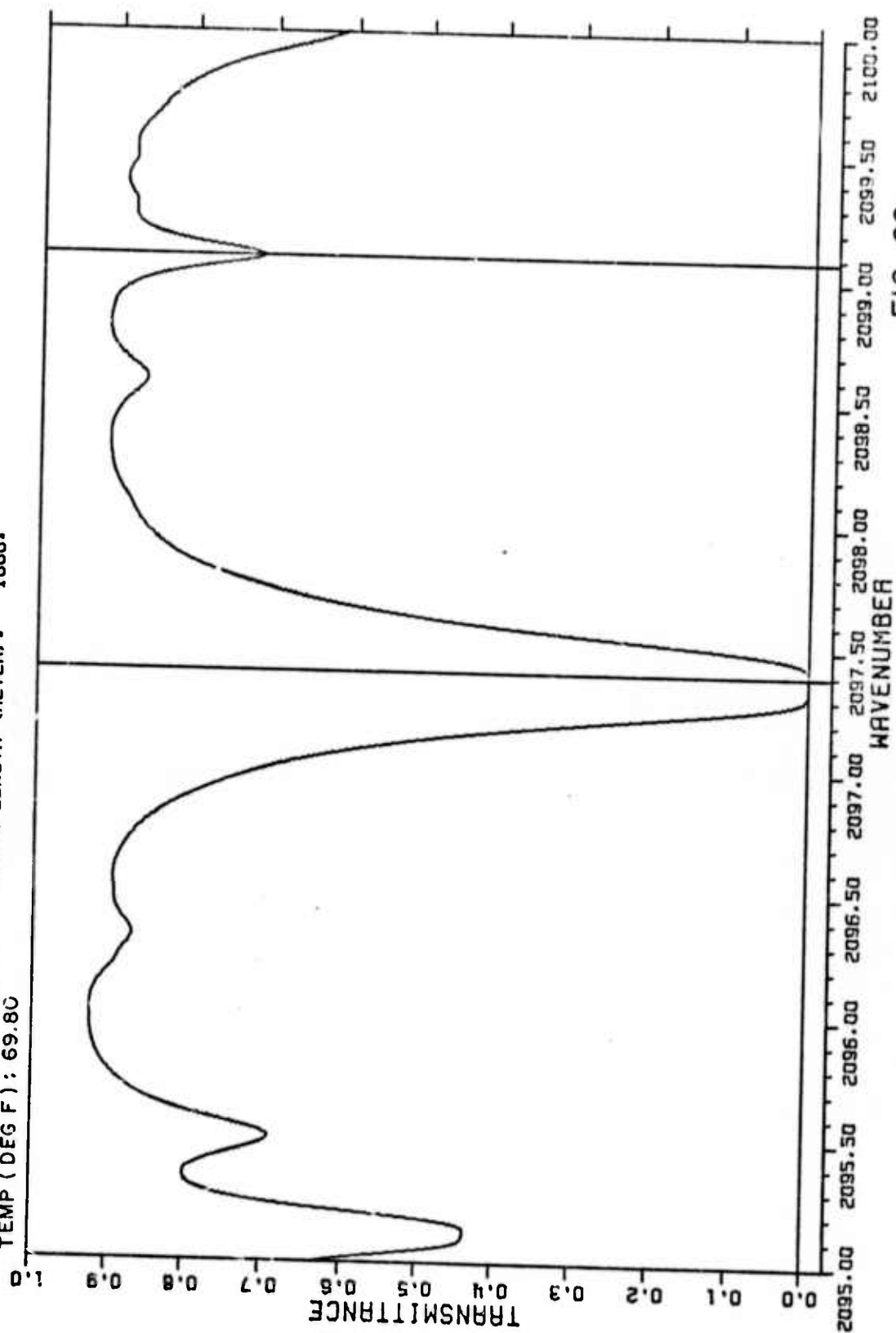


FIG. 65

ABSORBERS: H<sub>2</sub>O, CO<sub>2</sub>, CO 02/24/74  
AMOUNTS (TORR): 14.25, 0.251, TOTAL PRESSURE (TORR): 760.0  
5.7 E-5 PATH LENGTH (METER): 1000.  
TEMP (DEG F): 69.80



ABSORBERS: H<sub>2</sub>O, CO<sub>2</sub>, CO  
 AMOUNTS (TORR): 14.26, 0.251, 5.7E-5  
 TEMP (DEG F): 69.80  
 02/24/74  
 TOTAL PRESSURE (TORR): 760.0  
 PATH LENGTH (METER): 1000.

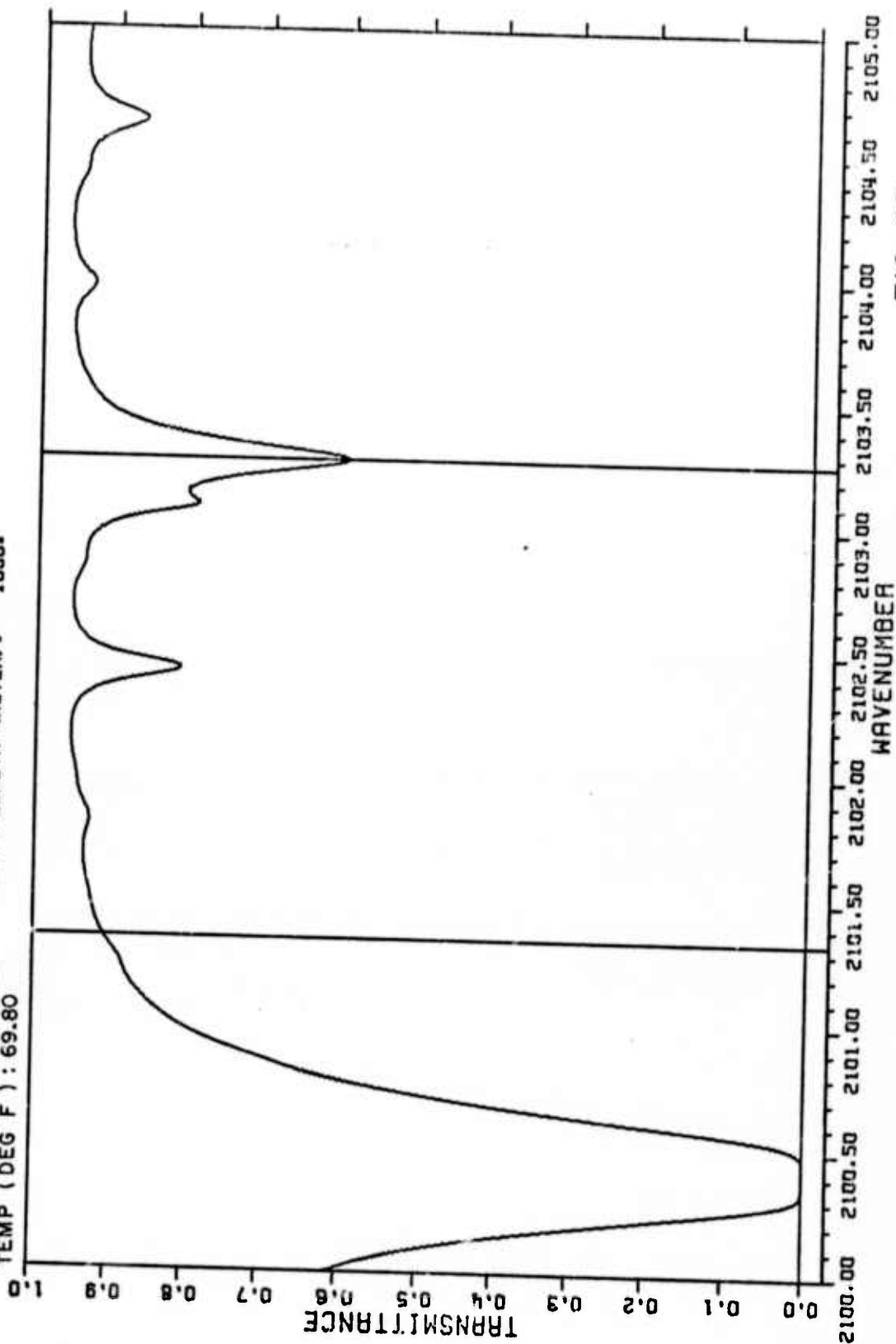


FIG. 67

ABSORBERS: H<sub>2</sub>O, CO<sub>2</sub>, CO  
AMOUNT (TORR): 14.26, 0.251,  
5.7E-5  
TEMP (DEG F): 69.80

02/24/74  
TOTAL PRESSURE (TORR): 760.0  
PATH LENGTH (CMETER): 1000.

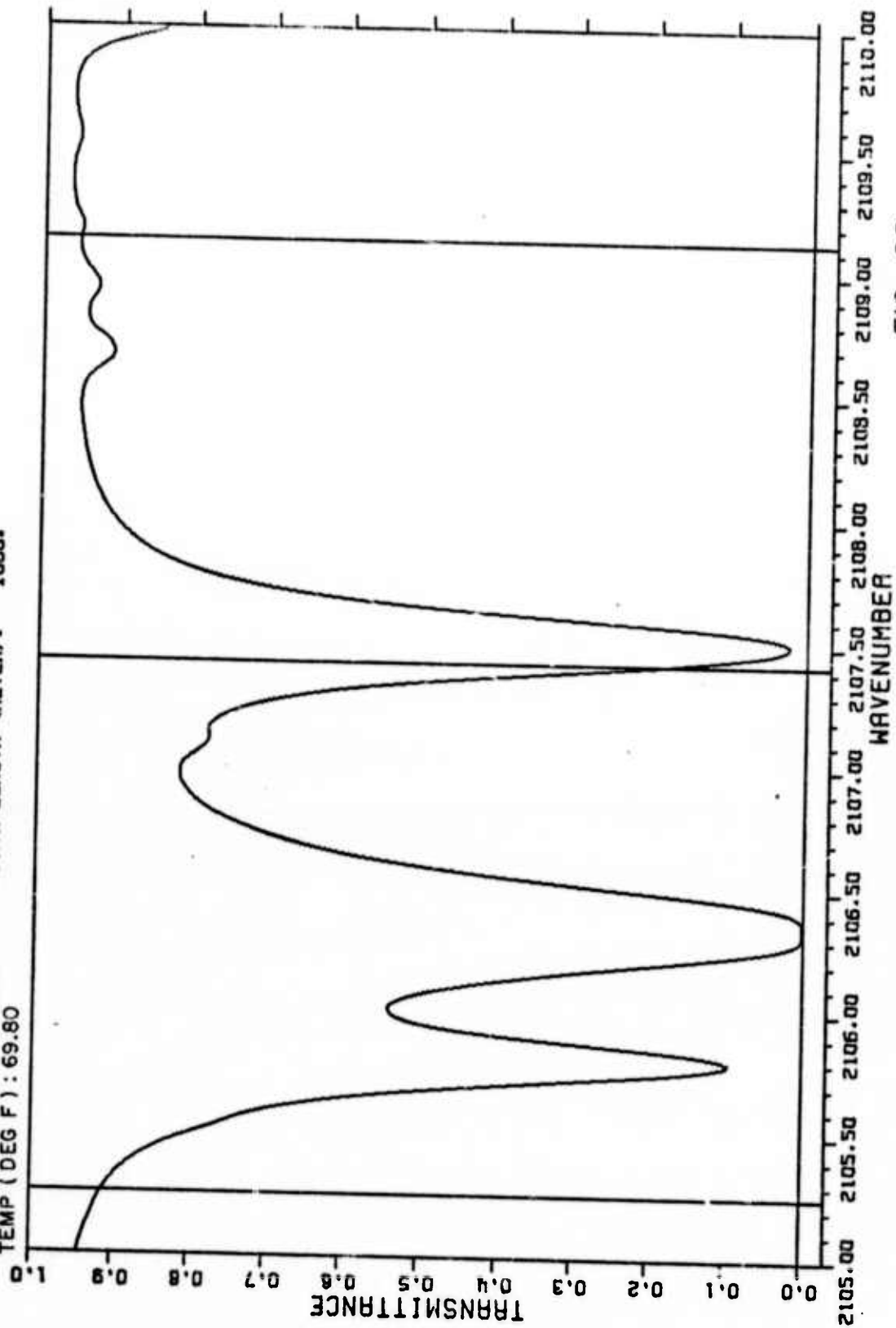
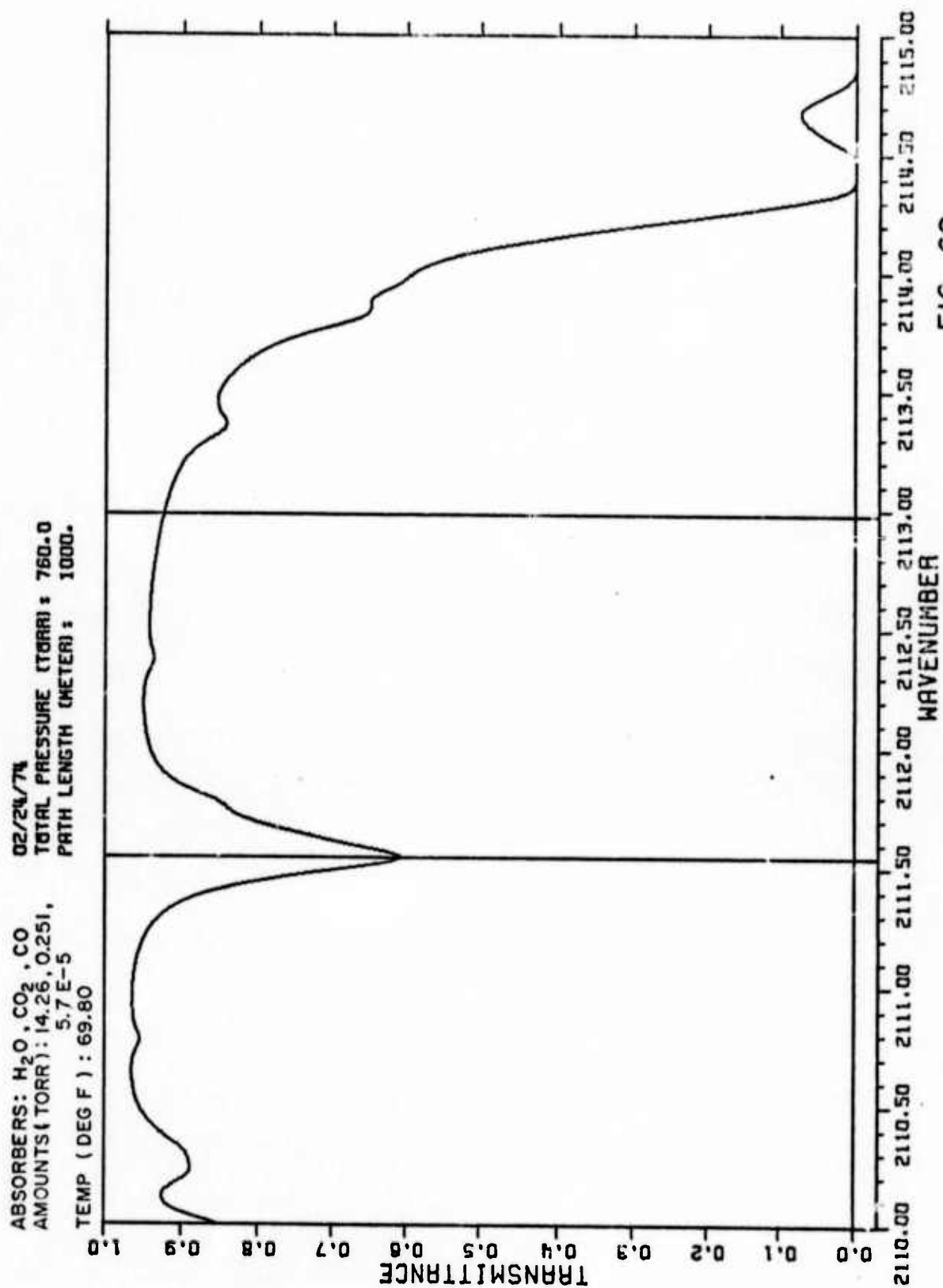


FIG. 68



A decorative border with a repeating scroll-like pattern surrounds the central text.

## MISSION of *Rome Air Development Center*

RADC is the principal AFSC organization charged with planning and executing the USAF exploratory and advanced development programs for electromagnetic intelligence techniques, reliability and compatibility techniques for electronic systems, electromagnetic transmission and reception, ground based surveillance, ground communications, information displays and information processing. This Center provides technical or management assistance in support of studies, analyses, development planning activities, acquisition, test, evaluation, modification, and operation of aerospace systems and related equipment.